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Wind-Tunnel Force and Flow-Visualization Data at Mach Numbers From 1.6 to 4.63 for a Series of Bodies of Revolution at Angles of Attack From -4° to 60°

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Wind-Tunnel Force and Flow-Visualization Data at Mach Numbers From 1.6 to 4.63 for a Series of Bodies of Revolution at Angles of Attack From -4° to 60°

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and Space Administration

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SUMMARY

Flow-visualization and force data for a series of six bodies of revolution are presented without analysis. The data were obtained in the Langley Unitary Plan wind tunnel for angles of attack from -4° to 60°. The Reynolds number used for these tests was 6.6×10^{6} per meter (2.0×10^{6} per foot).

INTRODUCTION

Theoretical aerodynamicists are continually seeking consistent and accurate experimental data to evaluate both their theories and their computational methods. However, at the present time there is a lack of available, consistent experimental data on bodies of revolution at high angles of attack for both subsonic and supersonic speeds. Most of the existing high-angle-of-attack data, particularly pressure data, have been obtained on specific missile configurations. Typically, these missile data include the effects of control surfaces and receive limited distribution because of proprietary and/or security classification. To provide the theoretician with a consistent set of referenceable, high-angle-of-attack data at both subsonic and supersonic speeds, a series of six body-of-revolution wind-tunnel models which can be described analytically has been designed. The various body shapes were selected to provide insight into the effects of nose bluntness, variations in midsection slope, and afterbody closure.

A test program has been initiated to provide pressure, force, and flow-visualization data at high angles of attack for both subsonic and supersonic speeds. The results of pressure tests at supersonic speeds have been presented in reference 1. The purpose of this report is to present, without analysis, the supersonic flow-visualization and force data. The tests were conducted in the Langley Unitary Plan wind tunnel at Mach numbers of 1.6, 2.3, 2.96, and 4.63 for angles of attack from -4° to 60°. The Reynolds number used for these tests was 6.6×10^{6} per meter (2.0×10^{6} per foot).

SYMBOLS

Values are given in both SI and U.S. Customary Units. The measurements and calculations were made in U.S. Customary Units.

$C_N \quad = \dfrac{\text{Normal force}}{q_{\infty}S}$ (CN in computer-generated tables)

$C_A \quad = \dfrac{\text{Axial force}}{q_{\infty}S}$ (CA in computer-generated tables)

C_m $= \dfrac{\text{Pitching moment}}{q_\infty S l}$, measured about nose (CM in computer-generated tables)

C_l $= \dfrac{\text{Rolling moment}}{q_\infty SD}$, measured about body axis (CLB in computer-generated tables)

C_n $= \dfrac{\text{Yawing moment}}{q_\infty SD}$, measured about nose (CNB in computer-generated tables)

C_Y $= \dfrac{\text{Side force}}{q_\infty S}$ (CY in computer-generated tables)

D reference diameter, 7.62 cm (3.0 in.)

l body length, 50.8 cm (20 in.)

M_∞ free-stream Mach number (M in computer-generated tables)

p_t tunnel stagnation pressure, N/m^2 (lbf/ft^2)

p_∞ free-stream static pressure, N/m^2 (lbf/ft^2)

q_∞ free-stream dynamic pressure, N/m^2 (lbf/ft^2)

r body radius, cm (in.)

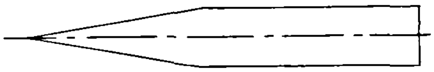
S reference area, 0.004560 m^2 (0.04909 ft^2)

x longitudinal distance along body, measured from nose, cm (in.)

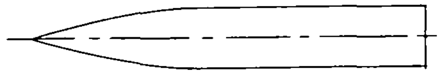
α angle of attack (ALPHA in computer-generated tables), deg

DESCRIPTION OF MODELS

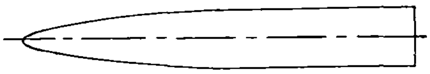
Simple body shapes which could be defined analytically were considered most useful for developing a subsonic/supersonic experimental data base. Six models representing various amounts of nose bluntness, midsection slope, and afterbody closure were designed; each has a circular cross section. (See following sketch.)



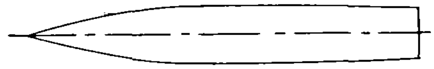
1. Cone-cylinder



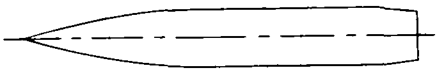
2. Circular-arc—cylinder



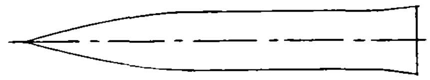
3. Blunt-nose—cylinder



4. Circular-arc—circular-arc



5. Circular-arc—cylinder—boattail



6. Circular-arc—cylinder—flare

Meridian lines for each of the models are described as follows:

1. Cone-cylinder

$$r/l = 0.16667x/l \qquad (0 < x/l < 0.45)$$

$$r/l = 0.075 \qquad (0.45 < x/l < 1.0)$$

2. Circular-arc—cylinder

$$r/l = \sqrt{(1.3125)^2 + (x/l)(0.9 - x/l)} - 1.3125 \qquad (0 < x/l < 0.45)$$

$$r/l = 0.075 \qquad (0.45 < x/l < 1.0)$$

3. Blunt-nose—cylinder

$$r/l = 0.1118\sqrt{x/l} \qquad (0 < x/l < 0.45)$$

$$r/l = 0.075 \qquad (0.45 < x/l < 1.0)$$

4. Circular-arc—circular-arc

$$r/l = \sqrt{(1.3125)^2 + (x/l)(0.9 - x/l)} - 1.3125 \qquad (0 < x/l < 0.45)$$

$$r/l = \sqrt{(14.41)^2 - (x/l - 0.45)^2} - 14.335 \qquad (0.45 < x/l < 1.0)$$

5. Circular-arc—cylinder—boattail

$$r/l = \sqrt{(1.3125)^2 + (x/l)(0.9 - x/l)} - 1.3125 \qquad (0 < x/l < 0.45)$$

$$r/l = 0.075 \qquad (0.45 < x/l < 0.9)$$

$$r/l = 0.075 - 0.105(x/l - 0.9) \qquad (0.9 < x/l < 1.0)$$

6. Circular-arc—cylinder—flare

$$r/l = \sqrt{(1.3125)^2 + (x/l)(0.9 - x/l)} - 1.3125 \qquad (0 < x/l < 0.45)$$

$$r/l = 0.075 \qquad (0.45 < x/l < 0.9)$$

$$r/l = 0.075 + 0.105(x/l - 0.9) \qquad (0.9 < x/l < 1.0)$$

TESTS

Tunnel Description

Tests were conducted in the high and low Mach number test sections of the Langley Unitary Plan wind tunnel, which is a variable Mach number, variable-pressure, continuous-flow tunnel. For a detailed description of the facility, see reference 2.

Test Measurements

All tests were conducted at a free-stream Reynolds number of 6.6×10^6 per meter (2.0×10^6 per foot). The stagnation temperature was maintained at 338 K (150° F) for Mach numbers of 1.6, 2.3, and 2.96 and at 352 K (175° F) for a Mach number of 4.63. No transition strips were applied to the models. Other tunnel parameters were as follows:

M_∞	q_∞		p_t		p_∞	
	kN/m^2	lbf/ft^2	kN/m^2	lbf/ft^2	kN/m^2	lbf/ft^2
1.6	23	482	55	1143	13	269
2.3	22	453	73	1529	6	122
2.96	18	385	104	2170	3	63
4.63	11	233	253	5280	.8	16

The models were sting mounted on the tunnel support system at a sideslip angle of 0°. In order to correct for test-section flow angularity, an angle of attack of 0° was obtained by adjusting the angle of attack until a six-component strain-gage balance indicated a normal-force coefficient of zero. The range of angle of attack was from -4° to 60°. Dewpoint was maintained below 239 K (-29° F) during the force tests to insure negligible condensation effects.

Force Tests

Aerodynamic forces and moments were measured by means of a six-component strain-gage balance housed within each model. The nominal angle-of-attack range was from -4° to 60°. Because the nose of each model was in the tunnel wall boundary layer at the higher angles of attack, the angle of attack was limited to 48° at a Mach number of 1.6. This was not a problem at the higher Mach numbers.

Estimated accuracies, based on 0.5-percent balance accuracy, for the tabulated coefficients at Mach numbers of 1.6 and 4.63 are as follows:

	Estimated accuracy at -	
	$M_{\infty} = 1.6$	$M_{\infty} = 4.63$
C_N	±0.063	±0.131
C_A	±.008	±.017
C_m	±.011	±.022
C_l	±.014	±.029
C_n	±.011	±.022
C_Y	±.063	±.131

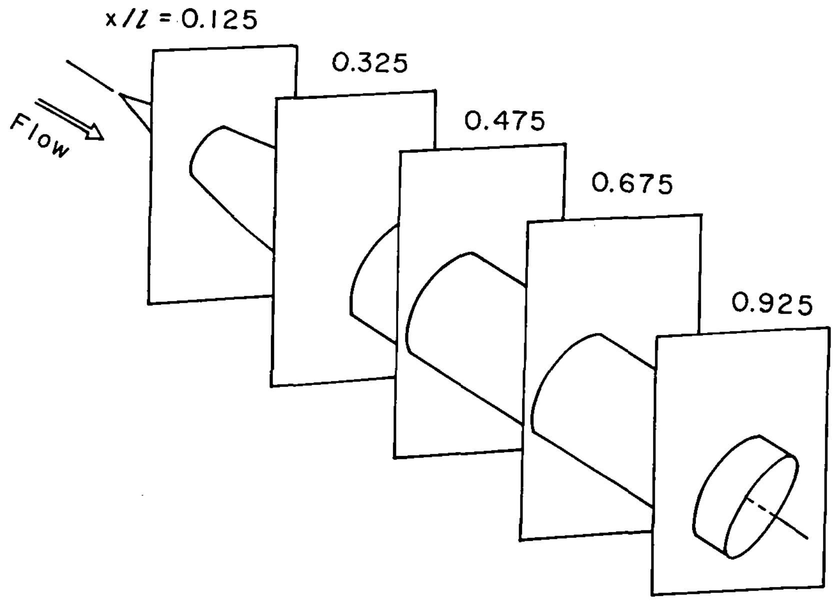
For the circular-arc—cylinder—flare and circular-arc—cylinder—boattail models, photographs were not taken at stations 0.125, 0.325, and 0.475 for most angles of attack since these models were identical to the circular-arc—cylinder model forward of the flare and boattail.

Flow-Visualization Tests

Schlieren.- Except where the tunnel wall boundary layer interfered (at $M_{\infty} = 1.6$ for $\alpha = 52^{\circ}$ and 60°), schlieren photographs were taken at all Mach numbers for nine angles of attack: 0°, 4°, 12°, 20°, 28°, 36°, 44°, 52°, and 60°. Photographs for some angles of attack are not available because of camera malfunctions.

Vapor screen.- At all Mach numbers except $M_{\infty} = 1.6$, vapor screen photographs were obtained at the highest six angles of attack corresponding to those for the schlieren photographs. Vapor screen photographs were taken at six

longitudinal model stations: x/l = 0.125, 0.325, 0.475, 0.675, 0.925, and 1.000. (See following sketch.)



Oil flow.- Oil-flow photographs were taken at all Mach numbers. Angles of attack corresponded to those for the schlieren photographs beginning at $\alpha = 12^\circ$.

At stations 0.125, 0.325, 0.475, 0.675, and 0.925, dots were placed around the body to indicate the angular location of the flow. Average angular separation of the dots was as follows:

Model	Angular separation, deg, of reference dots at x/l of -				
	0.125	0.325	0.475	0.675	0.925
Cone-cylinder	81.0	31.2	22.5	22.5	22.5
Circular-arc—cylinder	46.4	24.3	↓	↓	↓
Blunt-nose—cylinder	42.7	26.5	↓	↓	↓
Circular-arc—circular-arc	46.4	24.3	↓	23.1	25.1
Circular-arc—cylinder—boattail	↓	↓	↓	22.5	23.3
Circular-arc—cylinder—flare	↓	↓	↓	22.5	21.7

In mounting the models on the sting mechanism, it was not always possible to aline a dot with the 90° location. As a result the 90° position is shown by the cross hairs behind the model (figs. 7 to 12). The top of the model (leeward side) is 0°.

PRESENTATION OF RESULTS

Results of the tests are presented as follows:

Model	Mach number	Force data	Schlieren and vapor-screen photographs	Oil-flow photographs
Cone-cylinder	1.6	Table I	Figure 1(a)	Figure 7(a)
	2.3	↓	1(b)	7(b)
	2.96	↓	1(c)	7(c)
	4.63	↓	1(d)	7(d)
Circular-arc—cylinder	1.6	Table II	Figure 2(a)	Figure 8(a)
	2.3	↓	2(b)	8(b)
	2.96	↓	2(c)	8(c)
	4.63	↓	2(d)	8(d)
Blunt-nose—cylinder	1.6	Table III	Figure 3(a)	Figure 9(a)
	2.3	↓	3(b)	9(b)
	2.96	↓	3(c)	9(c)
	4.63	↓	3(d)	9(d)
Circular-arc—circular-arc	1.6	Table IV	Figure 4(a)	Figure 10(a)
	2.3	↓	4(b)	10(b)
	2.96	↓	4(c)	10(c)
	4.63	↓	4(d)	10(d)
Circular-arc—cylinder—flare	1.6	Table V	Figure 5(a)	Figure 11(a)
	2.3	↓	5(b)	11(b)
	2.96	↓	5(c)	11(c)
	4.63	↓	5(d)	11(d)
Circular-arc—cylinder—boattail	1.6	Table VI	Figure 6(a)	Figure 12(a)
	2.3	↓	6(b)	12(b)
	2.96	↓	6(c)	12(c)
	4.63	↓	6(d)	12(d)

No analysis of the data is made.

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National Aeronautics and Space Administration
Hampton, VA 23665
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REFERENCES

1. Landrum, Emma Jean: Wind-Tunnel Pressure Data at Mach Numbers From 1.6 to 4.63 for a Series of Bodies of Revolution at Angles of Attack From -4° to 60°. NASA TM X-3558, 1977.

2. Schaefer, William T., Jr.: Characteristics of Major Active Wind Tunnels at the Langley Research Center. NASA TM X-1130, 1965.

TABLE I.- AERODYNAMIC COEFFICIENTS FOR THE CONE-CYLINDER MODEL

M = 1.60

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.1723	.1547	.0639	-.0000	.0847	-.0160	-3.99
-1.99	-.0854	.1518	.0334	-.0001	.0864	-.0144	-1.99
-.00	-.0004	.1452	.0058	.0004	.0623	-.0104	-.00
2.01	.0799	.1505	-.0179	.0008	.0767	-.0129	2.01
4.03	.1731	.1542	-.0518	.0013	.0737	-.0127	4.03
6.01	.2669	.1514	-.0864	.0011	.0623	-.0106	6.01
7.61	.3491	.1474	-.1194	.0014	.0614	-.0111	7.61
9.97	.5024	.1445	-.1903	.0019	.0750	-.0130	9.97
12.01	.6651	.1380	-.2709	.0024	.0619	-.0086	12.01
16.01	1.1402	.1202	-.5444	.0028	.0099	.0014	16.01
19.99	1.8632	.1077	-.9956	.0037	-.1042	.0259	19.99
24.01	2.6022	.0997	-1.4242	.0041	-.3978	.0904	24.01
28.01	3.2827	.0975	-1.8020	.0055	-.7056	.1558	28.01
31.97	3.9845	.1015	-2.2112	.0066	-1.1602	.2648	31.97
36.05	4.6528	.1128	-2.6036	.0071	-.0012	.0175	36.05
40.02	5.3072	.1253	-2.9962	.0084	.1633	-.0599	40.02
44.03	6.1279	.1282	-3.5089	.0109	.4276	-.0218	44.03
48.12	6.7373	.1417	-3.8728	.0120	.2803	-.0368	48.12

M = 2.30

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.00	-.2092	.1324	.0959	.0083	.1262	-.0286	-4.00
-2.01	-.1018	.1322	.0494	.0080	.1078	-.0253	-2.01
.00	-.0056	.1325	.0093	.0076	.1150	-.0286	.00
2.01	.0954	.1350	-.0318	.0078	.0994	-.0254	2.01
3.99	.2025	.1330	-.0780	.0074	.1086	-.0284	3.99
6.00	.3317	.1321	-.1374	.0068	.1078	-.0283	6.00
8.00	.4787	.1295	-.2103	.0069	.1053	-.0279	8.00
10.00	.6622	.1269	-.3082	.0065	.1168	-.0306	10.00
12.00	.8751	.1242	-.4284	.0062	.1253	-.0311	12.00
16.00	1.4016	.1203	-.7386	.0054	.1565	-.0373	16.00
19.99	1.9697	.1276	-1.0546	.0051	.1662	-.0389	19.99
24.01	2.5758	.1463	-1.3916	.0045	.0721	-.0183	24.01
28.01	3.0969	.1637	-1.6907	.0026	-.0072	.0006	28.01
32.01	3.6665	.1887	-2.0243	.0020	.2953	-.0686	32.01
36.01	4.2799	.2149	-2.3922	.0016	.2182	-.0499	36.01
40.00	4.8831	.2373	-2.7564	.0006	.2257	-.0523	40.00
44.01	5.4726	.2668	-3.1160	.0004	.1754	-.0454	44.01
48.02	6.0429	.2903	-3.4643	.0001	.1723	-.0417	48.02
52.01	6.5566	.3096	-3.7737	-.0016	.1776	-.0412	52.01
56.00	7.0296	.3257	-4.0647	-.0024	.1775	-.0404	56.00
60.01	7.4545	.3408	-4.3385	-.0042	.2036	-.0419	60.01

TABLE I.- Concluded

M = 2.96

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.98	-.2219	.1130	.1058	-.0005	.0730	-.0187	-3.98
-2.00	-.1088	.1103	.0521	-.0010	.0561	-.0157	-2.00
.00	-.0033	.1038	.0042	-.0016	.0378	-.0129	.00
2.01	.0968	.1137	-.0391	-.0022	.0490	-.0151	2.01
4.00	.2229	.1154	-.0999	-.0020	.0432	-.0142	4.00
6.01	.3646	.1170	-.1704	-.0022	.0447	-.0150	6.01
7.98	.5269	.1180	-.2560	-.0022	.0374	-.0129	7.98
10.01	.7282	.1181	-.3681	-.0022	.0481	-.0147	10.01
12.00	.9408	.1192	-.4887	-.0028	.0665	-.0188	12.00
16.00	1.3981	.1266	-.7418	-.0037	.0623	-.0182	16.00
19.99	1.8688	.1428	-.9990	-.0039	.0606	-.0193	19.99
24.01	2.4099	.1717	-1.3037	-.0045	.0632	-.0190	24.01
27.99	2.8768	.1950	-1.5749	-.0064	.1059	-.0290	27.99
31.99	3.4252	.2241	-1.9003	-.0065	.1074	-.0318	31.99
36.00	4.0024	.2527	-2.2466	-.0071	.0656	-.0241	36.00
40.00	4.5850	.2818	-2.6014	-.0085	.0764	-.0221	40.00
44.00	5.1443	.3135	-2.9436	-.0102	.0918	-.0257	44.00
48.01	5.6749	.3421	-3.2614	-.0113	.1021	-.0274	48.01
52.02	6.1973	.3653	-3.5841	-.0120	.1246	-.0327	52.02
56.01	6.6873	.3838	-3.8947	-.0135	.1375	-.0344	56.01
60.01	7.1186	.3977	-4.1756	-.0147	.1399	-.0337	60.01

M = 4.63

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.01	-.2358	.1026	.1092	-.0106	.0665	-.0169	-4.01
-2.00	-.1142	.0965	.0505	-.0098	.0553	-.0150	-2.00
.00	-.0054	.0870	.0026	-.0101	.0668	-.0173	.00
2.00	.1077	.0997	-.0499	-.0093	.0529	-.0155	2.00
4.01	.2253	.1015	-.1048	-.0096	.0494	-.0137	4.01
6.01	.3594	.1050	-.1720	-.0095	.0492	-.0151	6.01
8.00	.5234	.1102	-.2603	-.0093	.0344	-.0116	8.00
10.00	.6885	.1150	-.3460	-.0101	.0538	-.0160	10.00
12.01	.8607	.1240	-.4360	-.0098	.0338	-.0124	12.01
16.00	1.2258	.1471	-.6303	-.0093	.0367	-.0132	16.00
20.00	1.6107	.1719	-.8378	-.0098	.0613	-.0175	20.00
24.00	2.0927	.2098	-1.1138	-.0101	.0615	-.0196	24.00
28.00	2.5531	.2389	-1.3833	-.0106	.0669	-.0193	28.00
32.01	3.0694	.2699	-1.6910	-.0108	.0806	-.0214	32.01
36.00	3.6125	.3026	-2.0152	-.0131	.0811	-.0224	36.00
40.01	4.1751	.3347	-2.3535	-.0120	.0837	-.0231	40.01
44.00	4.7408	.3703	-2.6952	-.0135	.1103	-.0286	44.00
48.01	5.2943	.4062	-3.0304	-.0152	.1064	-.0270	48.01
51.99	5.8366	.4348	-3.3661	-.0157	.1320	-.0329	51.99
56.01	6.3404	.4549	-3.6903	-.0178	.1528	-.0380	56.01
60.00	6.7708	.4578	-3.9865	-.0216	.1583	-.0379	60.00

TABLE II.- AERODYNAMIC COEFFICIENTS FOR THE CIRCULAR-ARC—CYLINDER MODEL

M = 1.60

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.00	-.1707	.1468	.0435	.0015	.1847	-.0295	-4.00
-2.01	-.0814	.1682	.0221	.0016	.1816	-.0279	-2.01
.01	.0038	.1643	.0055	.0021	.1912	-.0285	.01
2.01	.0930	.1564	-.0168	.0022	.1954	-.0289	2.01
3.99	.1827	.1531	-.0375	.0022	.1937	-.0273	3.99
6.01	.2807	.1553	-.0632	.0027	.1870	-.0266	6.01
8.01	.3933	.1544	-.0976	.0026	.1995	-.0315	8.01
9.98	.5175	.1526	-.1420	.0029	.1778	-.0261	9.98
12.01	.6869	.1461	-.2121	.0035	.1778	-.0250	12.01
15.99	1.2831	.1401	-.5485	.0050	.2214	-.0347	15.99
20.01	2.0674	.1332	-.9839	.0050	.2510	-.0396	20.01
24.01	2.8173	.1259	-1.3765	.0069	.1974	-.0296	24.01
28.01	3.5698	.1166	-1.7867	.0090	.2494	-.0406	28.01
32.00	4.2999	.1230	-2.1896	.0107	.1964	-.0301	32.00
36.02	5.0358	.1317	-2.6039	.0124	.1411	-.0177	36.02
39.99	5.7567	.1473	-3.0198	.0147	.1190	-.0151	39.99
44.00	6.5078	.1628	-3.4590	.0161	.2639	-.0246	44.00
48.01	7.1807	.1748	-3.8496	.0179	.1539	-.0173	48.01

M = 2.30

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2124	.1411	.0634	-.0069	.0914	-.0249	-3.99
-2.00	-.1031	.1302	.0302	-.0078	.0908	-.0242	-2.00
-.00	.0038	.1287	-.0050	-.0072	.0713	-.0218	-.00
2.00	.1061	.1316	-.0369	-.0077	.0650	-.0214	2.00
4.01	.2151	.1387	-.0705	-.0082	.0524	-.0206	4.01
6.02	.3458	.1429	-.1199	-.0083	.0553	-.0209	6.02
8.01	.4960	.1441	-.1823	-.0090	.0557	-.0190	8.01
10.02	.6826	.1439	-.2697	-.0096	.0788	-.0242	10.02
12.01	.9331	.1442	-.4063	-.0110	.1189	-.0335	12.01
16.01	1.5159	.1464	-.7317	-.0114	.1507	-.0395	16.01
20.00	2.0997	.1536	-1.0353	-.0127	.1673	-.0437	20.00
24.00	2.7394	.1781	-1.3725	-.0141	.1585	-.0413	24.00
28.02	3.3149	.1939	-1.6832	-.0149	.1525	-.0418	28.02
31.99	3.9204	.2150	-2.0203	-.0157	.1824	-.0484	31.99
36.00	4.5680	.2390	-2.3883	-.0160	.1579	-.0431	36.00
39.98	5.2120	.2496	-2.7565	-.0176	.1575	-.0444	39.98
44.01	5.8838	.2766	-3.1457	-.0179	.1606	-.0447	44.01
48.01	6.5104	.2988	-3.5075	-.0189	.1683	-.0443	48.01
52.00	7.1353	.3190	-3.8706	-.0189	.1547	-.0407	52.00
56.01	7.6605	.3325	-4.1727	-.0189	.1618	-.0366	56.01
60.01	8.1304	.3407	-4.4542	-.0199	.1612	-.0344	60.01

TABLE II.- Concluded

M = 2.96

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2248	.1275	.0781	-.0122	.0834	-.0219	-3.99
-1.99	-.1127	.1179	.0369	-.0116	.0865	-.0227	-1.99
-.01	-.0032	.1165	-.0042	-.0117	.0745	-.0210	-.01
2.01	.1143	.1200	-.0486	-.0118	.0578	-.0189	2.01
4.02	.2373	.1309	-.0928	-.0111	.0441	-.0165	4.02
5.99	.3752	.1357	-.1484	-.0122	.0669	-.0204	5.99
8.01	.5437	.1387	-.2263	-.0126	.0714	-.0214	8.01
10.01	.7537	.1403	-.3357	-.0128	.0755	-.0215	10.01
12.00	.9868	.1436	-.4613	-.0134	.1031	-.0275	12.00
16.01	1.4648	.1643	-.7108	-.0130	.0959	-.0263	16.01
20.00	1.9582	.1702	-.9657	-.0137	.1028	-.0289	20.00
24.00	2.5319	.1916	-1.2698	-.0154	.1217	-.0334	24.00
28.00	3.0528	.2132	-1.5559	-.0162	.1272	-.0356	28.00
31.99	3.6412	.2389	-1.8851	-.0166	.1330	-.0360	31.99
35.99	4.2697	.2653	-2.2433	-.0174	.1274	-.0352	35.99
40.01	4.9077	.2910	-2.6089	-.0176	.1223	-.0344	40.01
44.00	5.5537	.3206	-2.9811	-.0183	.1281	-.0353	44.00
47.99	6.1720	.3481	-3.3367	-.0178	.1405	-.0374	47.99
52.01	6.7484	.3717	-3.6665	-.0187	.1398	-.0378	52.01
56.02	7.2859	.3889	-3.9870	-.0194	.1402	-.0358	56.02
60.02	7.7513	.3953	-4.2804	-.0200	.1102	-.0277	60.02

M = 4.63

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2412	.1183	.1022	.0034	.0850	-.0197	-3.99
-1.99	-.1135	.1127	.0470	.0027	.0637	-.0159	-1.99
.00	.0015	.1107	.0031	.0042	.0450	-.0125	.00
1.99	.1118	.1128	-.0401	.0045	.0451	-.0134	1.99
3.98	.2438	.1188	-.0957	.0038	.0523	-.0136	3.98
5.99	.3800	.1257	-.1557	.0035	.0587	-.0162	5.99
8.00	.5407	.1309	-.2331	.0032	.0558	-.0150	8.00
9.99	.7054	.1371	-.3112	.0006	.0901	-.0214	9.99
12.00	.8888	.1456	-.4015	.0007	.0932	-.0223	12.00
16.00	1.2756	.1653	-.5948	.0010	.1061	-.0270	16.00
20.00	1.7050	.1878	-.8162	-.0006	.1224	-.0303	20.00
23.99	2.2374	.2235	-1.1040	-.0006	.1235	-.0301	23.99
28.01	2.7425	.2500	-1.3844	-.0031	.1672	-.0391	28.01
32.02	3.3236	.2822	-1.7088	-.0029	.1311	-.0332	32.02
35.99	3.9295	.3109	-2.0500	-.0037	.1433	-.0351	35.99
39.99	4.5376	.3398	-2.3917	-.0055	.1633	-.0405	39.99
44.00							44.00
48.00	5.7642	.4082	-3.0940	-.0089	.2004	-.0467	48.00
52.01	6.3672	.4353	-3.4477	-.0096	.1908	-.0446	52.01
56.00	6.8877	.4399	-3.7810	-.0111	.2113	-.0472	56.00
60.00	7.3642	.4326	-4.0966	-.0140	.2259	-.0515	60.00

TABLE III.- AERODYNAMIC COEFFICIENTS FOR THE BLUNT-NOSE—CYLINDER MODEL

M = 1.60

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.00	-.1866	.1184	.0517	.0014	.0410	-.0050	-4.00
-2.02	-.1051	.1163	.0335	.0009	.0516	-.0068	-2.02
.02	-.0173	.1153	.0104	.0009	.0639	-.0103	.02
1.99	.0725	.1160	-.0157	.0016	.0646	-.0115	1.99
4.01	.1559	.1184	-.0359	.0016	.0803	-.0134	4.01
6.01	.2440	.1215	-.0560	.0018	.1000	-.0154	6.01
7.99	.3448	.1238	-.0873	.0020	.0757	-.0107	7.99
10.01	.4635	.1236	-.1297	.0025	.0747	-.0114	10.01
12.03	.6161	.1177	-.1903	.0028	.0767	-.0110	12.03
16.04	1.1026	.1104	-.4462	.0036	.0614	-.0100	16.04
20.02	1.9119	.1015	-.9144	.0046	.0386	-.0038	20.02
24.00	2.6901	.0951	-1.3128	.0062	.0997	-.0195	24.00
27.99	3.4406	.0871	-1.7130	.0074	.1546	-.0238	27.99
31.99	4.1970	.0941	-2.1257	.0095	.0118	.0004	31.99
36.02	4.9455	.1056	-2.5431	.0113	.0470	-.0089	36.02
39.99	5.6766	.1202	-2.9550	.0132	.0341	-.0080	39.99
43.99	6.3812	.1356	-3.3646	.0147	.0861	-.0119	43.99
47.99	7.1102	.1486	-3.7924	.0160	-.0021	-.0042	47.99

M = 2.30

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.00	-.1952	.1119	.0648	-.0020	.0605	-.0177	-4.00
-1.99	-.0952	.1055	.0319	-.0023	.0471	-.0161	-1.99
-.01	.0024	.1040	-.0003	-.0031	.0454	-.0166	-.01
2.02	.1023	.1060	-.0341	-.0039	.0381	-.0150	2.02
4.01	.2086	.1137	-.0694	-.0042	.0255	-.0131	4.01
5.99	.3304	.1257	-.1146	-.0049	.0186	-.0113	5.99
8.00	.4786	.1232	-.1765	-.0060	.0231	-.0127	8.00
10.01	.6724	.1233	-.2709	-.0064	.0395	-.0172	10.01
12.02	.9192	.1228	-.4058	-.0077	.0607	-.0205	12.02
16.01	1.5172	.1253	-.7358	-.0092	.1211	-.0338	16.01
20.03	2.1078	.1316	-1.0398	-.0103	.1416	-.0375	20.03
24.00	2.7591	.1499	-1.3823	-.0116	.1231	-.0347	24.00
28.00	3.3350	.1662	-1.6922	-.0129	.1319	-.0355	28.00
32.00	3.9518	.1866	-2.0329	-.0140	.1426	-.0392	32.00
36.01	4.6090	.2107	-2.3999	-.0148	.1633	-.0421	36.01
40.00	5.2750	.2330	-2.7783	-.0157	.1814	-.0469	40.00
44.05	5.9286	.2595	-3.1509	-.0166	.1506	-.0415	44.05
48.03	6.5626	.2822	-3.5154	-.0182	.1207	-.0348	48.03
52.01	7.1803	.3025	-3.8713	-.0193	.1484	-.0392	52.01
56.01	7.6951	.3154	-4.1625	-.0193	.1386	-.0291	56.01
60.04	8.1658	.3240	-4.4455	-.0186	.1550	-.0295	60.04

TABLE III.- Concluded

M = 2.96

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2160	.1083	.0826	-.0140	.0683	-.0183	-3.99
-2.01	-.1041	.1070	.0371	-.0138	.0601	-.0173	-2.01
.00	.0001	.1096	-.0037	-.0136	.0375	-.0141	.00
2.02	.1045	.1142	-.0436	-.0128	.0090	-.0084	2.02
4.01	.2162	.1165	-.0854	-.0132	.0237	-.0122	4.01
6.01	.3512	.1185	-.1420	-.0135	.0205	-.0110	5.01
8.00	.5172	.1221	-.2211	-.0144	.0257	-.0114	8.00
10.02	.7300	.1242	-.3333	-.0137	.0443	-.0156	10.02
11.99	.9689	.1273	-.4624	-.0142	.0681	-.0213	11.99
16.00	1.4482	.1353	-.7097	-.0145	.0927	-.0271	16.00
20.00	1.9548	.1500	-.9707	-.0158	.0827	-.0243	20.00
24.00	2.5359	.1764	-1.2777	-.0166	.0999	-.0285	24.00
28.02	3.0616	.1983	-1.5626	-.0178	.0944	-.0279	28.02
32.02	3.6578	.2242	-1.8921	-.0173	.1079	-.0301	32.02
36.01	4.2862	.2504	-2.2450	-.0187	.1114	-.0314	36.01
40.01	4.9339	.2757	-2.6133	-.0193	.1000	-.0299	40.01
44.00	5.5697	.3049	-2.9764	-.0199	.1068	-.0309	44.00
48.00	6.1819	.3318	-3.3243	-.0200	.1182	-.0328	48.00
51.99	6.7495	.3539	-3.6447	-.0210	.1266	-.0336	51.99
56.00	7.2793	.3698	-3.9597	-.0211	.1225	-.0321	56.00
60.00	7.7381	.3739	-4.2555	-.0205	.1166	-.0272	60.00

M = 4.63

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.00	-.2100	.1101	.0871	-.0105	.0419	-.0123	-4.00
-1.99	-.0958	.1039	.0370	-.0119	.0289	-.0100	-1.99
.00	.0059	.1036	-.0043	-.0122	.0006	-.0042	.00
1.99	.1029	.1068	-.0424	-.0125	.0170	-.0067	1.99
4.02	.2217	.1114	-.0955	-.0128	.0039	-.0045	4.02
6.01	.3601	.1207	-.1607	-.0129	.0146	-.0067	6.01
7.99	.5169	.1253	-.2372	-.0141	.0217	-.0083	7.99
10.00	.6859	.1315	-.3177	-.0140	.0259	-.0093	10.00
12.00	.8739	.1412	-.4117	-.0149	.0263	-.0097	12.00
16.02	1.2733	.1626	-.6112	-.0145	.0201	-.0098	16.02
19.99	1.7061	.1837	-.8304	-.0161	.0579	-.0169	19.99
24.00	2.2397	.2182	-1.1138	-.0169	.0691	-.0198	24.00
28.01	2.7485	.2458	-1.3912	-.0180	.0756	-.0205	28.01
32.02	3.3233	.2718	-1.7094	-.0186	.0864	-.0228	32.02
35.99	3.9292	.3012	-2.0491	-.0203	.0929	-.0243	35.99
40.00	4.5493	.3304	-2.3955	-.0206	.1091	-.0290	40.00
43.99	5.1600	.3661	-2.7382	-.0212	.0985	-.0260	43.99
48.01	5.7784	.3992	-3.0888	-.0238	.1046	-.0261	48.01
52.02	6.3629	.4204	-3.4304	-.0257	.1530	-.0368	52.02
56.00	6.8787	.4261	-3.7606	-.0260	.1591	-.0354	56.00
60.00	7.3238	.4149	-4.0722	-.0261	.1665	-.0382	60.00

TABLE IV.- AERODYNAMIC COEFFICIENTS FOR THE CIRCULAR-ARC—CIRCULAR-ARC MODEL

M = 1.60

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.97	-.1609	.1512	.0372	.0010	.1094	-.0184	-3.97
-2.00	-.0837	.1493	.0246	.0009	.1073	-.0185	-2.00
.01	-.0019	.1484	.0121	.0011	.1184	-.0206	.01
1.98	.0778	.1514	-.0027	.0015	.1278	-.0210	1.98
3.99	.1531	.1551	-.0132	.0019	.1405	-.0233	3.99
6.02	.2326	.1587	-.0231	.0020	.1483	-.0270	6.02
8.03	.3317	.1641	-.0452	.0021	.1499	-.0243	8.03
10.04	.4543	.1673	-.0855	.0027	.1261	-.0185	10.04
12.04	.6146	.1698	-.1481	.0032	.1277	-.0175	12.04
16.01	1.2139	.1703	-.4926	.0042	.1033	-.0163	16.01
20.04	1.9818	.1685	-.9138	.0047	.1123	-.0153	20.04
24.01	2.6607	.1616	-1.2425	.0060	.1487	-.0244	24.01
28.01	3.3554	.1529	-1.6047	.0074	.1685	-.0258	28.01
32.01	4.0618	.1548	-1.9812	.0097	.0729	-.0076	32.01
36.01	4.7677	.1611	-2.3688	.0109	.1277	-.0208	36.01
39.96	5.4509	.1712	-2.7499	.0127	.1292	-.0270	39.96
44.04	6.1562	.1812	-3.1525	.0139	.1224	-.0271	44.04
47.99	6.8014	.1868	-3.5221	.0156	.0953	-.0255	47.99

M = 2.30

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.1943	.1473	.0551	.0047	.0977	-.0254	-3.99
-1.99	-.0945	.1379	.0261	.0045	.0878	-.0236	-1.99
.01	.0011	.1323	.0035	.0043	.0783	-.0236	.01
2.00	.0899	.1358	-.0173	.0040	.0740	-.0222	2.00
4.02	.1897	.1426	-.0448	.0038	.0635	-.0202	4.02
6.01	.3112	.1466	-.0849	.0030	.0791	-.0248	6.01
8.00	.4551	.1494	-.1423	.0022	.0727	-.0229	8.00
10.01	.6436	.1516	-.2313	.0016	.1147	-.0322	10.01
12.02	.8962	.1541	-.3669	.0015	.1473	-.0395	12.02
16.00	1.4495	.1572	-.6628	.0004	.1893	-.0494	16.00
19.99	1.9971	.1625	-.9354	-.0009	.1872	-.0483	19.99
24.02	2.6064	.1763	-1.2433	-.0011	.1826	-.0480	24.02
28.01	3.1359	.1883	-1.5203	-.0020	.1761	-.0456	28.01
32.00	3.7219	.2036	-1.8366	-.0032	.1906	-.0496	32.00
35.99	4.3422	.2194	-2.1770	-.0048	.2152	-.0548	35.99
40.01	4.9676	.2351	-2.5285	-.0052	.1848	-.0519	40.01
44.00	5.5946	.2530	-2.8831	-.0057	.2161	-.0562	44.00
48.02	6.2049	.2679	-3.2273	-.0068	.1802	-.0465	48.02
52.02	6.8104	.2781	-3.5712	-.0068	.1973	-.0477	52.02
56.02	7.3130	.2827	-3.8564	-.0075	.1970	-.0431	56.02
60.03	7.7891	.2844	-4.1415	-.0084	.2364	-.0472	60.03

TABLE IV.- Concluded

M = 2.96

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2088	.1296	.0760	-.0000	.1489	-.0346	-3.99
-1.99	-.1052	.1187	.0425	.0002	.1514	-.0359	-1.99
.02	-.0014	.1149	.0092	.0005	.1429	-.0348	.02
2.00	.0998	.1215	-.0242	.0007	.1246	-.0314	2.00
4.00	.2140	.1317	-.0633	.0003	.1186	-.0300	4.00
6.01	.3488	.1378	-.1159	-.0002	.1393	-.0342	6.01
8.01	.5120	.1412	-.1891	-.0005	.1426	-.0352	8.01
10.00	.7159	.1445	-.2943	-.0008	.1675	-.0403	10.00
11.99	.9404	.1476	-.4103	-.0007	.1869	-.0440	11.99
16.02	1.3913	.1545	-.6332	-.0016	.1752	-.0426	16.02
19.99	1.8593	.1663	-.8652	-.0024	.1955	-.0482	19.99
24.01	2.4078	.1878	-1.1452	-.0026	.2060	-.0502	24.01
28.00	2.8958	.2050	-1.4053	-.0034	.2131	-.0527	28.00
32.01	3.4589	.2243	-1.7103	-.0036	.1915	-.0479	32.01
36.01	4.0536	.2432	-2.0380	-.0038	.2031	-.0498	36.01
40.03	4.6654	.2609	-2.3814	-.0045	.2095	-.0511	40.03
44.00	5.2690	.2823	-2.7222	-.0046	.1804	-.0461	44.00
48.01	5.8629	.3000	-3.0557	-.0054	.2106	-.0513	48.01
52.01	6.4235	.3140	-3.3729	-.0058	.2351	-.0554	52.01
56.01	6.9344	.3199	-3.6769	-.0060	.2337	-.0550	56.01
60.00	7.3861	.3149	-3.9640	-.0060	.2115	-.0456	60.00

M = 4.63

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.00	-.2165	.1200	.0902	.0080	.2008	-.0435	-4.00
-2.00	-.1021	.1114	.0480	.0079	.1689	-.0368	-2.00
.02	.0031	.1099	.0113	.0087	.1834	-.0388	.02
1.99	.1040	.1120	-.0231	.0085	.1862	-.0407	1.99
4.00	.2265	.1178	-.0724	.0083	.1758	-.0381	4.00
6.01	.3616	.1243	-.1302	.0079	.1861	-.0411	6.01
8.00	.5097	.1294	-.1976	.0075	.2041	-.0442	8.00
10.00	.6666	.1345	-.2672	.0061	.2145	-.0466	10.00
12.00	.8300	.1414	-.3427	.0061	.2194	-.0479	12.00
16.02	1.2036	.1599	-.5227	.0053	.2182	-.0486	16.02
20.02	1.6032	.1781	-.7173	.0048	.2339	-.0524	20.02
24.03	2.1025	.2082	-.9761	.0049	.2339	-.0519	24.03
28.01	2.5654	.2272	-1.2223	.0036	.2567	-.0569	28.01
32.00	3.1134	.2500	-1.5204	.0028	.2470	-.0552	32.00
36.03	3.6938	.2706	-1.8379	.0034	.2260	-.0522	36.03
40.01	4.2751	.2902	-2.1579	.0006	.2708	-.0616	40.01
43.99	4.8630	.3174	-2.4871	.0011	.2911	-.0640	43.99
48.01	5.4577	.3412	-2.8227	-.0017	.2802	-.0620	48.01
52.01	6.0357	.3568	-3.1590	-.0014	.2998	-.0656	52.01
56.00	6.5588	.3584	-3.4800	-.0038	.3376	-.0720	56.00
60.01	6.9986	.3332	-3.7903	-.0038	.3355	-.0755	60.01

TABLE V.- AERODYNAMIC COEFFICIENTS FOR THE CIRCULAR-ARC—CYLINDER—FLARE MODEL

M = 1.60

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.1881	.1823	.0622	-.0001	.0697	-.0146	-3.99
-1.97	-.0918	.2073	.0357	-.0000	.0707	-.0125	-1.97
.01	.0023	.2020	.0094	.0002	.0644	-.0102	.01
2.00	.0981	.1945	-.0189	.0006	.0723	-.0119	2.00
4.01	.1901	.1911	-.0437	.0003	.0742	-.0118	4.01
6.01	.2946	.1869	-.0763	.0010	.0687	-.0110	6.01
8.02	.4135	.1826	-.1162	.0013	.0712	-.0117	8.02
10.00	.5464	.1777	-.1660	.0014	.0744	-.0103	10.00
12.04	.7233	.1702	-.2413	.0020	.0640	-.0106	12.04
16.03	1.3499	.1497	-.6052	.0032	.0878	-.0155	16.03
20.00	2.1442	.1422	-1.0553	.0036	.1358	-.0242	20.00
24.02	2.9062	.1336	-1.4576	.0058	.1374	-.0274	24.02
28.00	3.6672	.1255	-1.8814	.0073	.1913	-.0380	28.00
32.01	4.4401	.1328	-2.3167	.0094	.1488	-.0293	32.01
36.01	5.1866	.1467	-2.7474	.0113	.0264	-.0059	36.01
40.03	5.9374	.1680	-3.1842	.0136	.0136	-.0037	40.03
44.02	6.6981	.1796	-3.6392	.0145	.2575	-.0317	44.02
47.98	7.3639	.1907	-4.0257	.0162	.0745	-.0124	47.98

M = 2.30

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.00	-.2174	.1551	.0816	.0034	.1048	-.0253	-4.00
-2.00	-.1070	.1545	.0428	.0026	.0629	-.0194	-2.00
.01	-.0004	.1524	.0099	.0025	.0389	-.0176	.01
2.00	.1074	.1479	-.0278	.0028	.0667	-.0227	2.00
4.00	.2305	.1526	-.0729	.0021	.0792	-.0250	4.00
6.02	.3676	.1518	-.1275	.0013	.0919	-.0276	6.02
8.01	.5286	.1512	-.1998	.0005	.0968	-.0294	8.01
10.03	.7329	.1474	-.3021	.0000	.1257	-.0345	10.03
12.02	.9959	.1442	-.4510	-.0006	.1607	-.0432	12.02
16.00	1.6057	.1448	-.7977	-.0019	.1913	-.0478	16.00
20.00	2.2082	.1570	-1.1189	-.0023	.1925	-.0490	20.00
24.00	2.8792	.1750	-1.4835	-.0031	.2088	-.0527	24.00
27.99	3.4612	.1952	-1.8092	-.0040	.2048	-.0518	27.99
31.98	4.1084	.2234	-2.1817	-.0051	.2276	-.0574	31.98
36.00	4.7891	.2580	-2.5775	-.0061	.2119	-.0538	36.00
39.99	5.4714	.2914	-2.9797	-.0065	.2039	-.0526	39.99
44.02	6.1667	.3299	-3.3910	-.0068	.2241	-.0551	44.02
48.02	6.8086	.3636	-3.7682	-.0064	.2100	-.0515	48.02
52.01	7.4345	.3934	-4.1355	-.0082	.1910	-.0459	52.01
56.01	7.9649	.4164	-4.4383	-.0077	.1911	-.0419	56.01
60.01	8.4041	.4253	-4.6940	-.0083	.2365	-.0491	60.01

TABLE V.- Concluded

M = 2.96

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2364	.1382	.1044	-.0014	.1140	-.0272	-3.99
-1.99	-.1171	.1320	.0584	-.0012	.0962	-.0262	-1.99
.02	-.0008	.1203	.0125	-.0009	.1122	-.0283	.02
2.00	.1156	.1291	-.0359	-.0007	.0989	-.0277	2.00
4.00	.2447	.1405	-.0869	-.0010	.1225	-.0316	4.00
6.01	.3974	.1416	-.1567	-.0022	.1341	-.0332	6.01
8.02	.5841	.1431	-.2498	-.0018	.1390	-.0340	8.02
9.99	.8057	.1429	-.3717	-.0020	.1606	-.0388	9.99
12.01	1.0576	.1465	-.5107	-.0024	.1634	-.0389	12.01
15.99	1.5531	.1561	-.7781	-.0023	.1592	-.0389	15.99
19.99	2.0763	.1757	-1.0591	-.0028	.1754	-.0428	19.99
24.00	2.6940	.2098	-1.4009	-.0036	.1754	-.0437	24.00
28.02	3.2302	.2390	-1.7059	-.0043	.1813	-.0456	28.02
32.00	3.8544	.2771	-2.0685	-.0052	.1823	-.0450	32.00
36.01	4.5033	.3143	-2.4485	-.0053	.1726	-.0438	36.01
40.01	5.1629	.3512	-2.8351	-.0053	.1798	-.0449	40.01
44.01	5.8297	.3916	-3.2279	-.0054	.1760	-.0437	44.01
48.00	6.4562	.4304	-3.5946	-.0058	.1975	-.0488	48.00
52.02	7.0458	.4662	-3.9379	-.0062	.1817	-.0448	52.02
56.00	7.5572	.4915	-4.2446	-.0066	.1975	-.0471	56.00
60.01	8.0095	.5022	-4.5153	-.0073	.1965	-.0440	60.01

M = 4.63

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2616	.1213	.1184	-.0021	.0023	-.0027	-3.99
-2.00	-.1354	.1136	.0631	-.0033	.0231	-.0090	-2.00
-.00	-.0004	.1056	.0019	-.0024	.0279	-.0076	-.00
2.00	.1265	.1138	-.0578	-.0026	.0413	-.0105	2.00
3.99	.2600	.1201	-.1153	-.0049	.0485	-.0122	3.99
6.01	.4116	.1254	-.1887	-.0042	.0638	-.0153	6.01
8.01	.5764	.1335	-.2724	-.0057	.0773	-.0181	8.01
10.01	.7635	.1399	-.3689	-.0071	.0646	-.0160	10.01
12.01	.9500	.1500	-.4643	-.0068	.0862	-.0204	12.01
16.01	1.3668	.1772	-.6849	-.0071	.0760	-.0191	16.01
19.99	1.8113	.2053	-.9247	-.0083	.1029	-.0248	19.99
24.00	2.3933	.2537	-1.2557	-.0091	.0917	-.0229	24.00
28.03	2.9310	.2921	-1.5659	-.0091	.1074	-.0266	28.03
32.00	3.5339	.3336	-1.9141	-.0110	.1334	-.0323	32.00
36.00	4.1599	.3734	-2.2769	-.0105	.1201	-.0293	36.00
40.01	4.8064	.4146	-2.6506	-.0120	.1317	-.0331	40.01
44.00	5.4276	.4618	-3.0075	-.0127	.1457	-.0348	44.00
48.01	6.0425	.5074	-3.3626	-.0147	.1491	-.0366	48.01
52.01	6.6360	.5448	-3.7123	-.0168	.1843	-.0436	52.01
56.02	7.1632	.5594	-4.0428	-.0173	.1877	-.0425	56.02
59.98	7.5840	.5511	-4.3286	-.0175	.1730	-.0454	59.98

TABLE VI.- AERODYNAMIC COEFFICIENTS FOR THE

CIRCULAR-ARC—CYLINDER—BOATTAIL MODEL

M = 1.60

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.65	-.1520	.1706	.0265	.0023	.0624	-.0095	-3.65
-1.96	-.0763	.1838	.0108	.0018	.0656	-.0122	-1.96
-.00	.0000	.1869	-.0027	.0025	.0666	-.0111	-.00
2.01	.0805	.1798	-.0154	.0020	.0969	-.0160	2.01
4.02	.1675	.1770	-.0340	.0020	.1086	-.0185	4.02
6.02	.2600	.1788	-.0543	.0025	.1200	-.0202	6.02
8.02	.3604	.1811	-.0824	.0031	.0949	-.0152	8.02
10.00	.4825	.1815	-.1236	.0033	.0869	-.0117	10.00
11.98	.6349	.1799	-.1819	.0041	.0752	-.0088	11.98
16.03	1.1833	.1803	-.4790	.0049	.1300	-.0233	16.03
20.03	1.9669	.1752	-.9153	.0060	.1546	-.0256	20.03
24.04	2.7129	.1699	-1.2963	.0072	.2062	-.0344	24.04
27.99	3.4304	.1607	-1.6782	.0093	.2005	-.0377	27.99
32.03	4.1433	.1625	-2.0631	.0107	.1582	-.0295	32.03
35.99	4.8637	.1705	-2.4609	.0129	.0898	-.0116	35.99
40.02	5.5777	.1811	-2.8621	.0148	.0999	-.0201	40.02
43.99	6.2942	.1961	-3.2737	.0156	.1261	-.0146	43.99
48.04	6.9818	.2009	-3.6690	.0186	.1208	-.0165	48.04

M = 2.30

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-4.02	-.2114	.1551	.0703	.0018	.1096	-.0255	-4.02
-2.00	-.0997	.1447	.0378	.0009	.1019	-.0254	-2.00
-.01	-.0021	.1414	.0084	.0003	.1034	-.0264	-.01
2.01	.1003	.1463	-.0214	-.0007	.1048	-.0270	2.01
4.01	.2092	.1551	-.0557	-.0006	.1079	-.0275	4.01
5.99	.3333	.1631	-.0979	-.0032	.1208	-.0313	5.99
8.00	.4922	.1674	-.1648	-.0044	.1094	-.0281	8.00
10.00	.6795	.1699	-.2528	-.0061	.1310	-.0325	10.00
12.02	.9285	.1711	-.3860	-.0075	.1697	-.0417	12.02
16.02	1.5041	.1747	-.7003	-.0093	.2007	-.0492	16.02
19.99	2.0786	.1809	-.9922	-.0108	.2268	-.0555	19.99
24.00	2.7011	.1952	-1.3116	-.0116	.2183	-.0535	24.00
27.98	3.2417	.2069	-1.5977	-.0130	.2083	-.0511	27.98
32.00	3.8523	.2234	-1.9309	-.0141	.2325	-.0570	32.00
36.00	4.4875	.2409	-2.2837	-.0150	.2083	-.0520	36.00
40.01	5.1212	.2581	-2.6403	-.0155	.2093	-.0536	40.01
44.01	5.7684	.2787	-3.0090	-.0158	.2102	-.0527	44.01
48.03	6.3802	.2939	-3.3554	-.0170	.2082	-.0509	48.03
52.02	6.9862	.3035	-3.7014	-.0175	.1829	-.0432	52.02
56.01	7.4876	.3086	-3.9825	-.0175	.1622	-.0370	56.01
59.99	7.9355	.3048	-4.2559	-.0176	.1978	-.0406	59.99

TABLE VI.- Concluded

M = 2.96

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2295	.1371	.0912	-.0047	.1249	-.0297	-3.99
-2.01	-.1195	.1286	.0549	-.0041	.1131	-.0266	-2.01
-.01	-.0099	.1267	.0154	-.0042	.1033	-.0259	-.01
2.00	.0996	.1318	-.0241	-.0029	.1017	-.0256	2.00
4.02	.2196	.1426	-.0666	-.0030	.1093	-.0270	4.02
5.99	.3551	.1495	-.1203	-.0035	.0994	-.0255	5.99
8.01	.5234	.1538	-.1964	-.0045	.1234	-.0304	8.01
10.00	.7310	.1568	-.3029	-.0040	.1037	-.0271	10.00
12.00	.9648	.1602	-.4258	-.0053	.1289	-.0327	12.00
16.01	1.4257	.1675	-.6590	-.0059	.1416	-.0364	16.01
19.99	1.9121	.1800	-.9044	-.0069	.1534	-.0391	19.99
24.00	2.4759	.2034	-1.1959	-.0071	.1699	-.0435	24.00
28.00	2.9775	.2207	-1.4644	-.0077	.1630	-.0414	28.00
32.01	3.5542	.2418	-1.7795	-.0073	.1649	-.0418	32.01
36.02	4.1672	.2622	-2.1217	-.0087	.1572	-.0410	36.02
40.01	4.7831	.2806	-2.4672	-.0088	.1561	-.0405	40.01
44.01	5.4079	.3026	-2.8220	-.0095	.1757	-.0444	44.01
48.02	6.0103	.3219	-3.1620	-.0103	.1768	-.0439	48.02
52.00	6.5707	.3349	-3.4804	-.0106	.1807	-.0447	52.00
56.01	7.0986	.3429	-3.7925	-.0120	.1814	-.0453	56.01
60.00	7.5634	.3403	-4.0844	-.0133	.2094	-.0472	60.00

M = 4.63

ALPHA, DEG	CN	CA	CM	CLB	CNB	CY	ALPHA, DEG
-3.99	-.2300	.1288	.1074	.0026	.0462	-.0137	-3.99
-2.00	-.1160	.1223	.0641	.0019	.0609	-.0163	-2.00
-.01	-.0016	.1220	.0224	.0023	.0795	-.0190	-.01
2.00	.1041	.1247	-.0159	.0026	.0964	-.0219	2.00
4.01	.2317	.1312	-.0691	.0019	.0875	-.0201	4.01
5.99	.3702	.1364	-.1299	.0014	.0911	-.0219	5.99
8.01	.5268	.1425	-.2012	.0011	.0778	-.0192	8.01
10.01	.6909	.1490	-.2777	-.0014	.0753	-.0199	10.01
12.00	.8652	.1572	-.3606	-.0015	.0811	-.0207	12.00
16.02	1.2490	.1771	-.5490	-.0027	.0963	-.0251	16.02
20.01	1.6649	.1964	-.7561	-.0036	.1126	-.0284	20.01
23.99	2.1852	.2307	-1.0298	-.0045	.1083	-.0277	23.99
28.01	2.6666	.2508	-1.2884	-.0067	.1134	-.0288	28.01
32.02	3.2306	.2768	-1.5963	-.0063	.1268	-.0315	32.02
35.99	3.8165	.2989	-1.9193	-.0080	.1520	-.0372	35.99
40.00	4.4073	.3201	-2.2448	-.0085	.1553	-.0388	40.00
44.00	5.0070	.3486	-2.5809	-.0101	.1671	-.0399	44.00
48.00	5.6013	.3720	-2.9195	-.0117	.1556	-.0367	48.00
52.01	6.1829	.3889	-3.2571	-.0125	.1847	-.0431	52.01
56.00	6.6964	.3826	-3.5871	-.0151	.1891	-.0454	56.00
60.01	7.1498	.3627	-3.8941	-.0182	.2166	-.0513	60.01

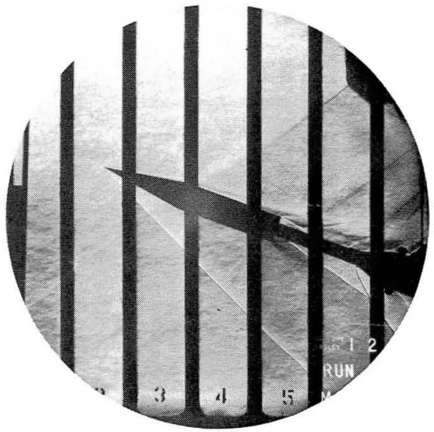
$\alpha = 0°$

$\alpha = 4°$

$\alpha = 12°$

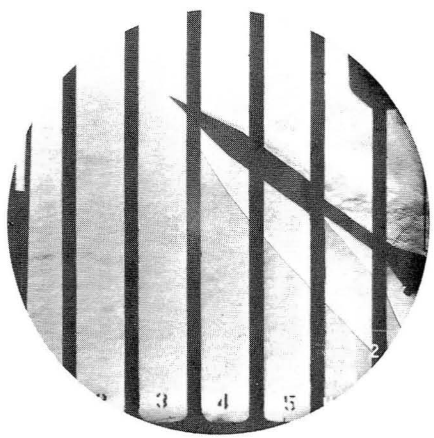
(a) $M_\infty = 1.6$.

Figure 1.- Schlieren and vapor-screen photographs for cone-cylinder model.

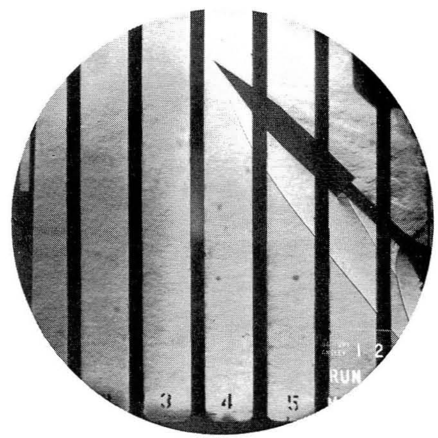


$\alpha = 20^\circ$

$\alpha = 28^\circ$



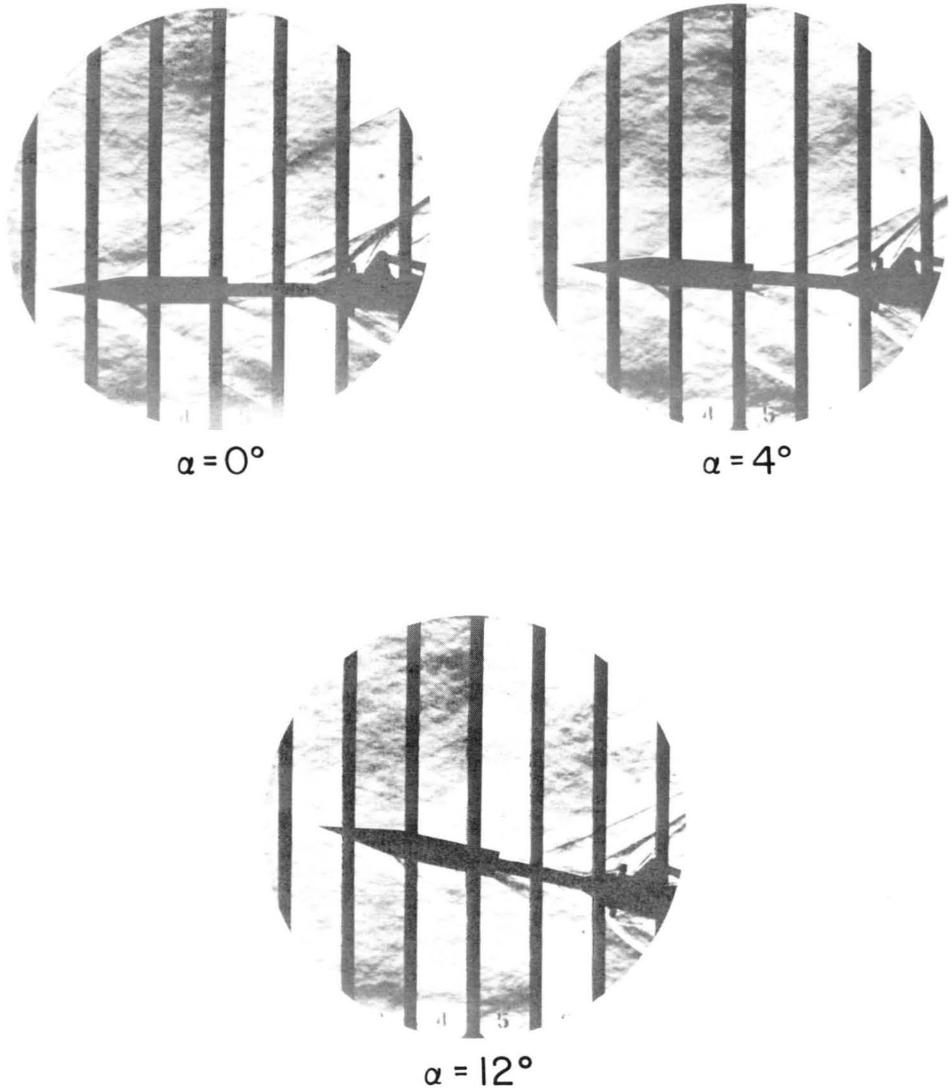
$\alpha = 36^\circ$



$\alpha = 44^\circ$

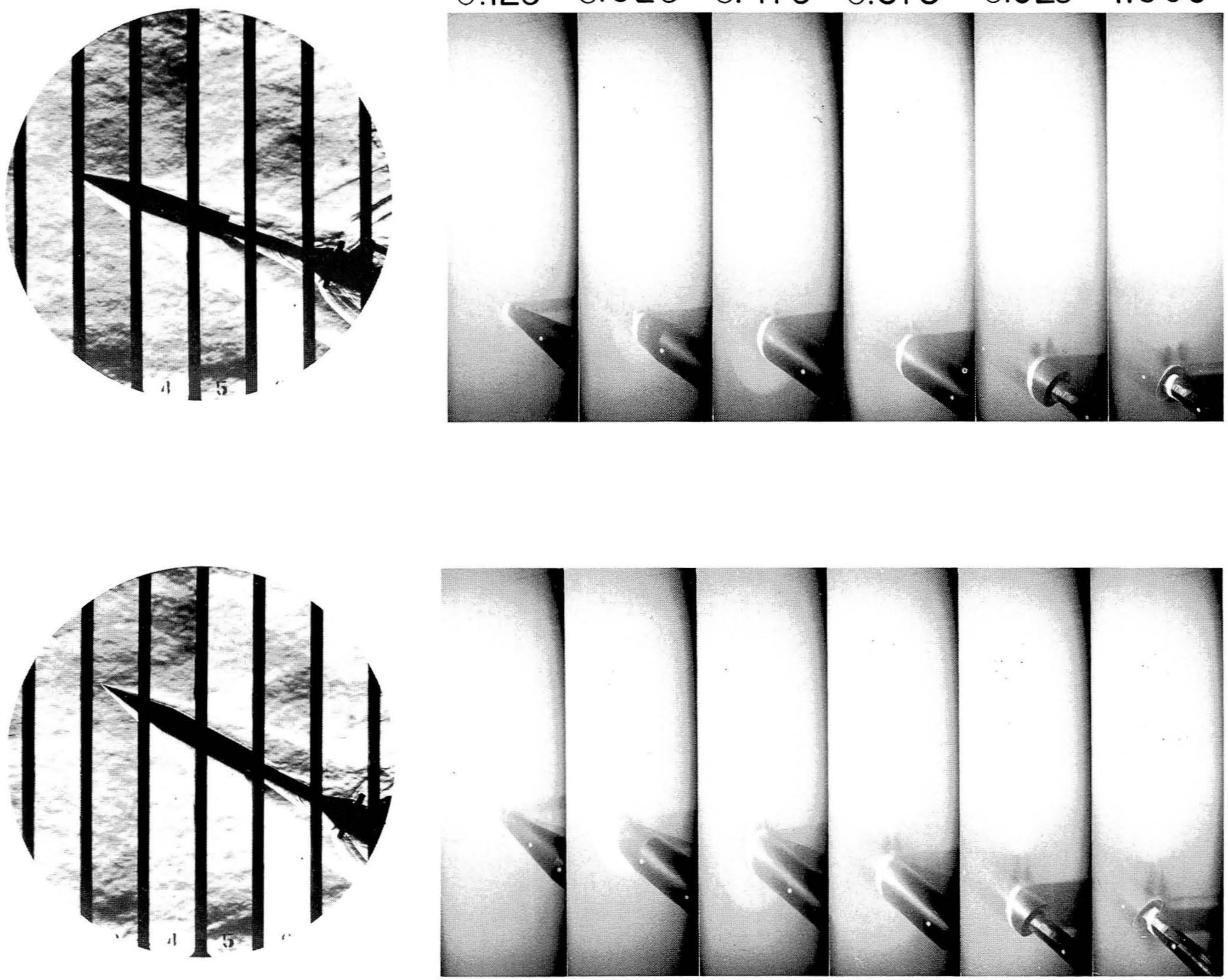
(a) Concluded.

Figure 1.- Continued.



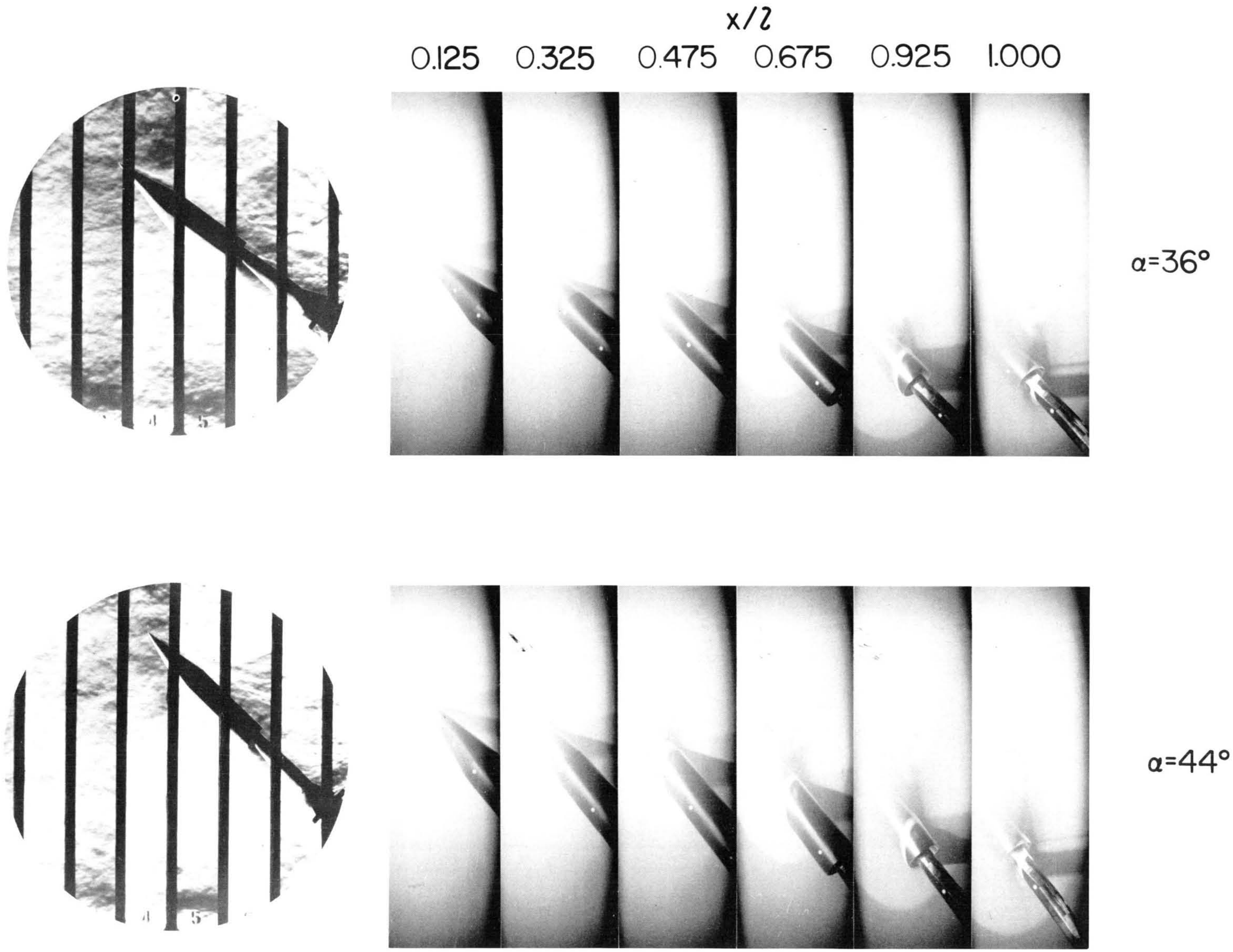
(b) $M_\infty = 2.3$.

Figure 1.- Continued.



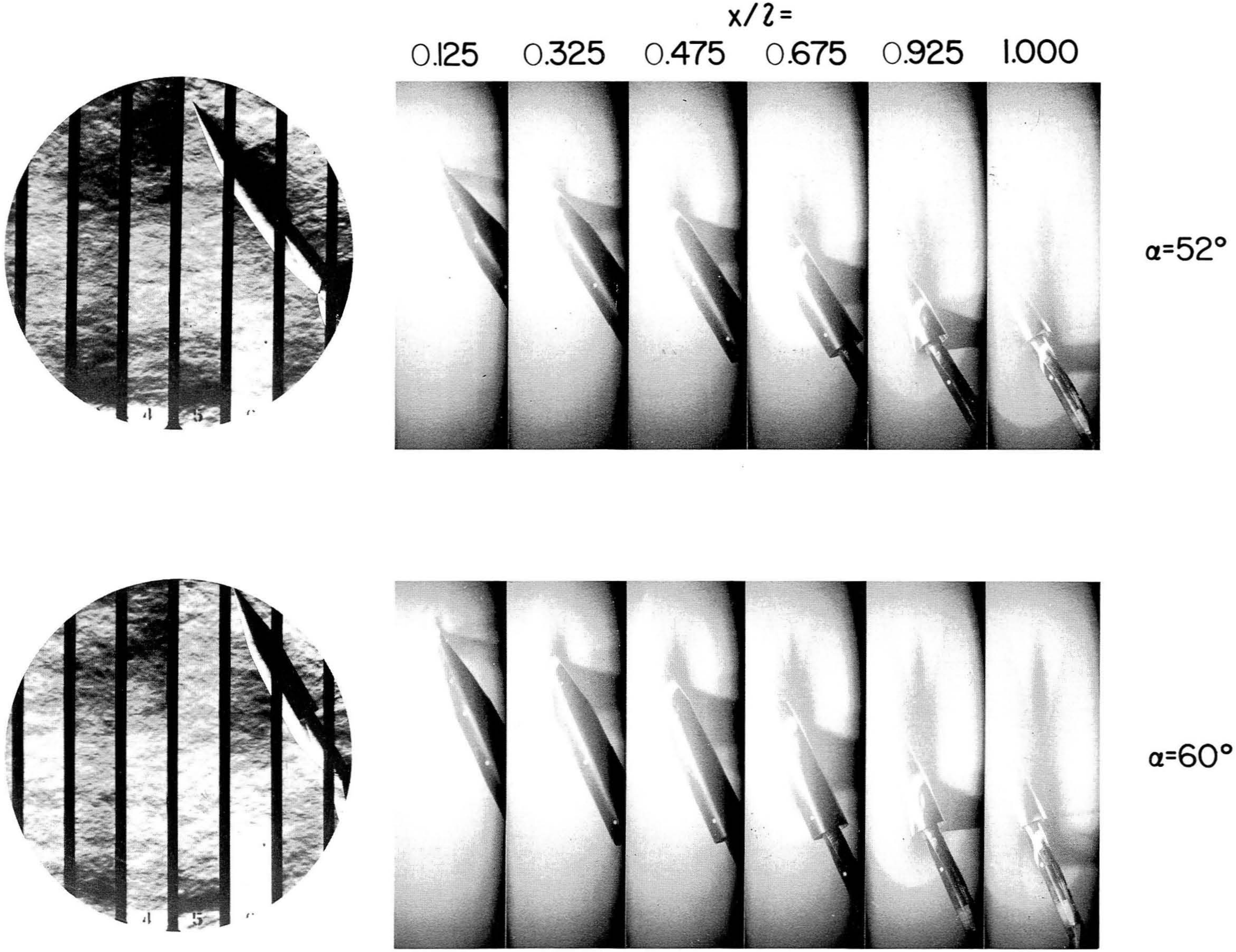
(b) Continued.

Figure 1.- Continued.



(b) Continued.

Figure 1.- Continued.



(b) Concluded.

Figure 1.- Continued.

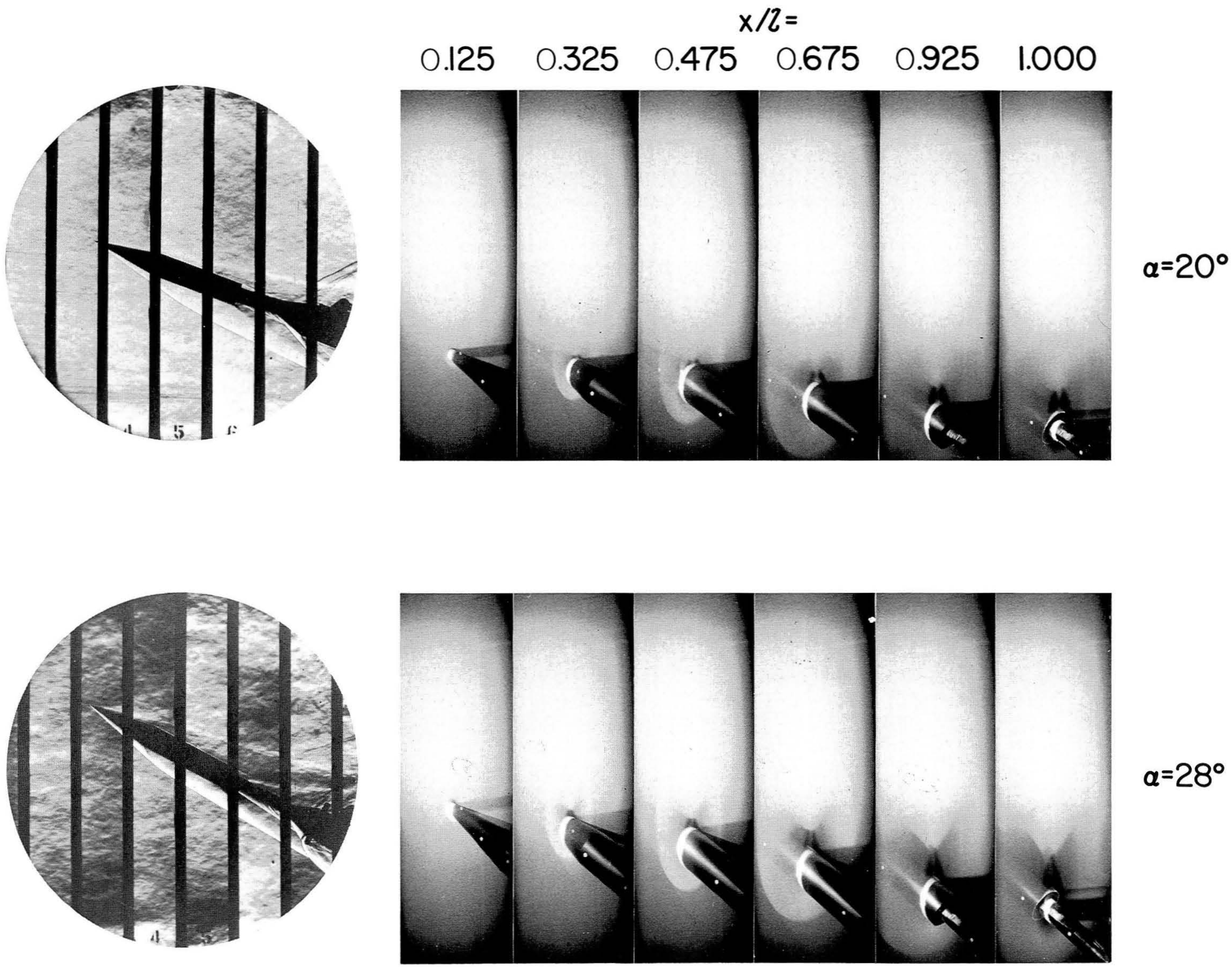
$\alpha=0°$

$\alpha=4°$

$\alpha=12°$

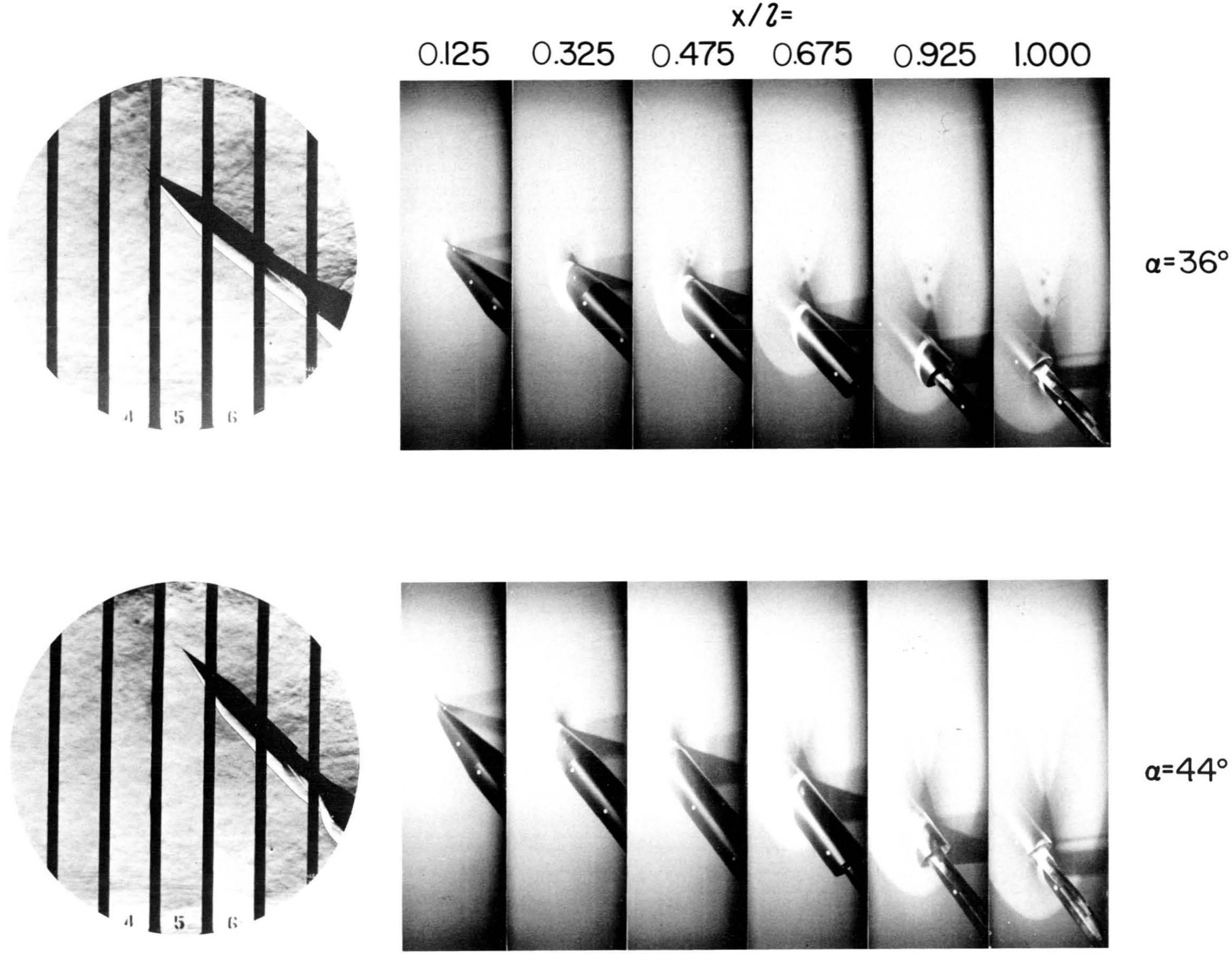
(c) $M_\infty = 2.96$.

Figure 1.- Continued.



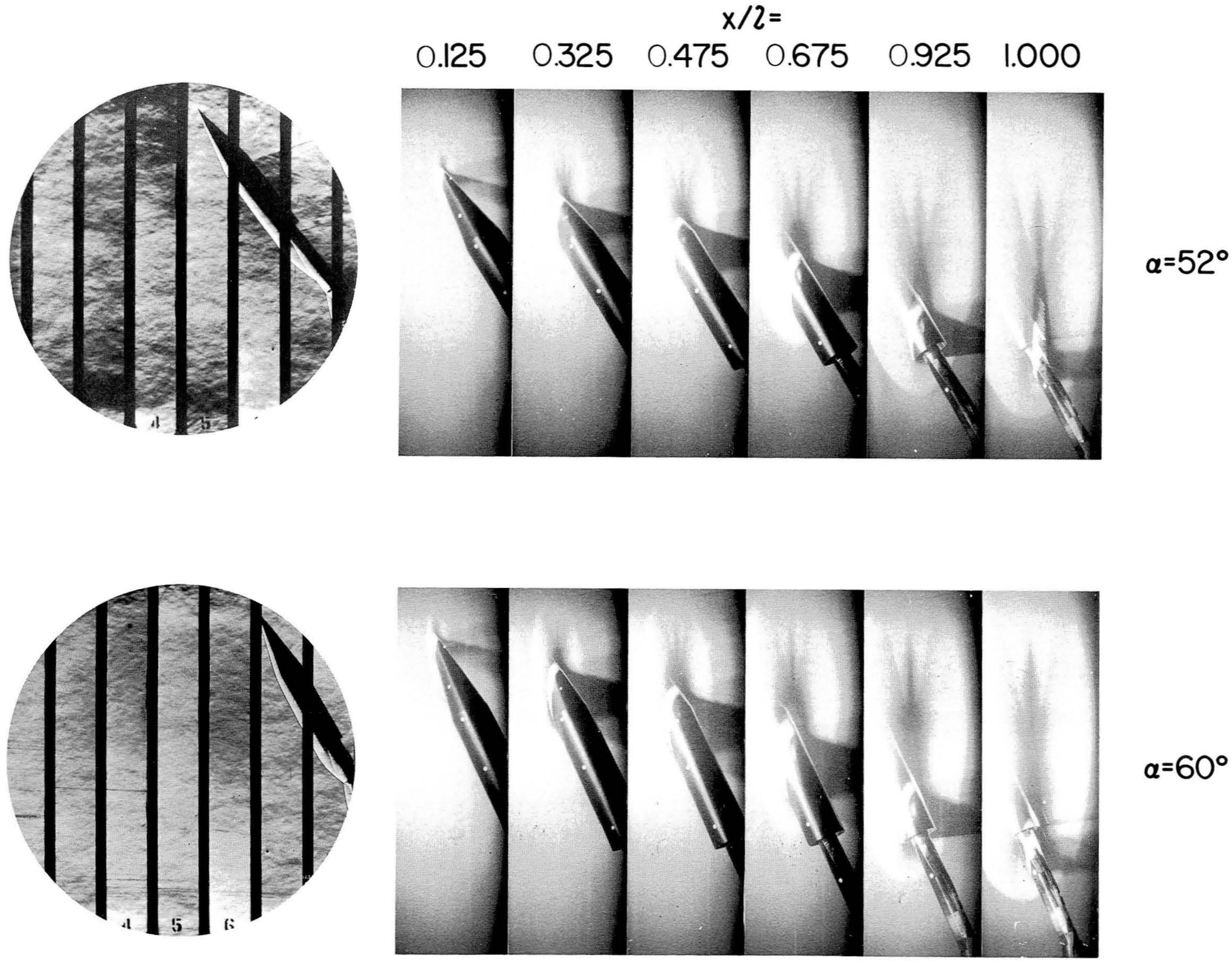
(c) Continued.

Figure 1.- Continued.



(c) Continued.

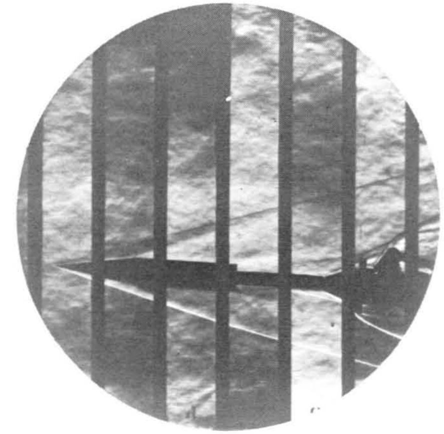
Figure 1.- Continued.



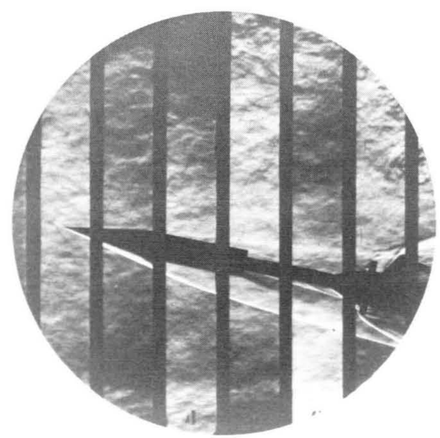
(c) Concluded.

Figure 1.- Continued.

α=0°



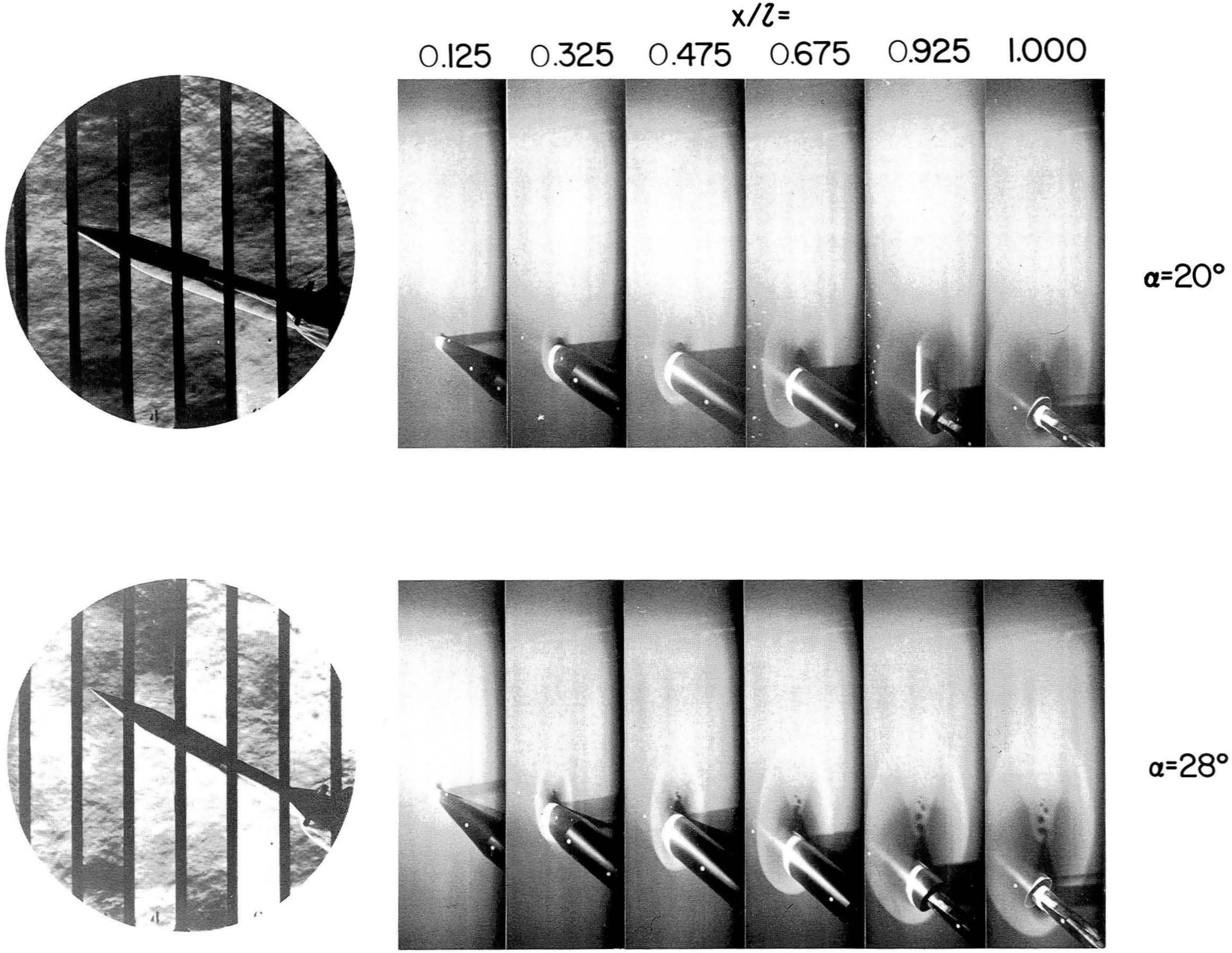
α=4°



α=12°

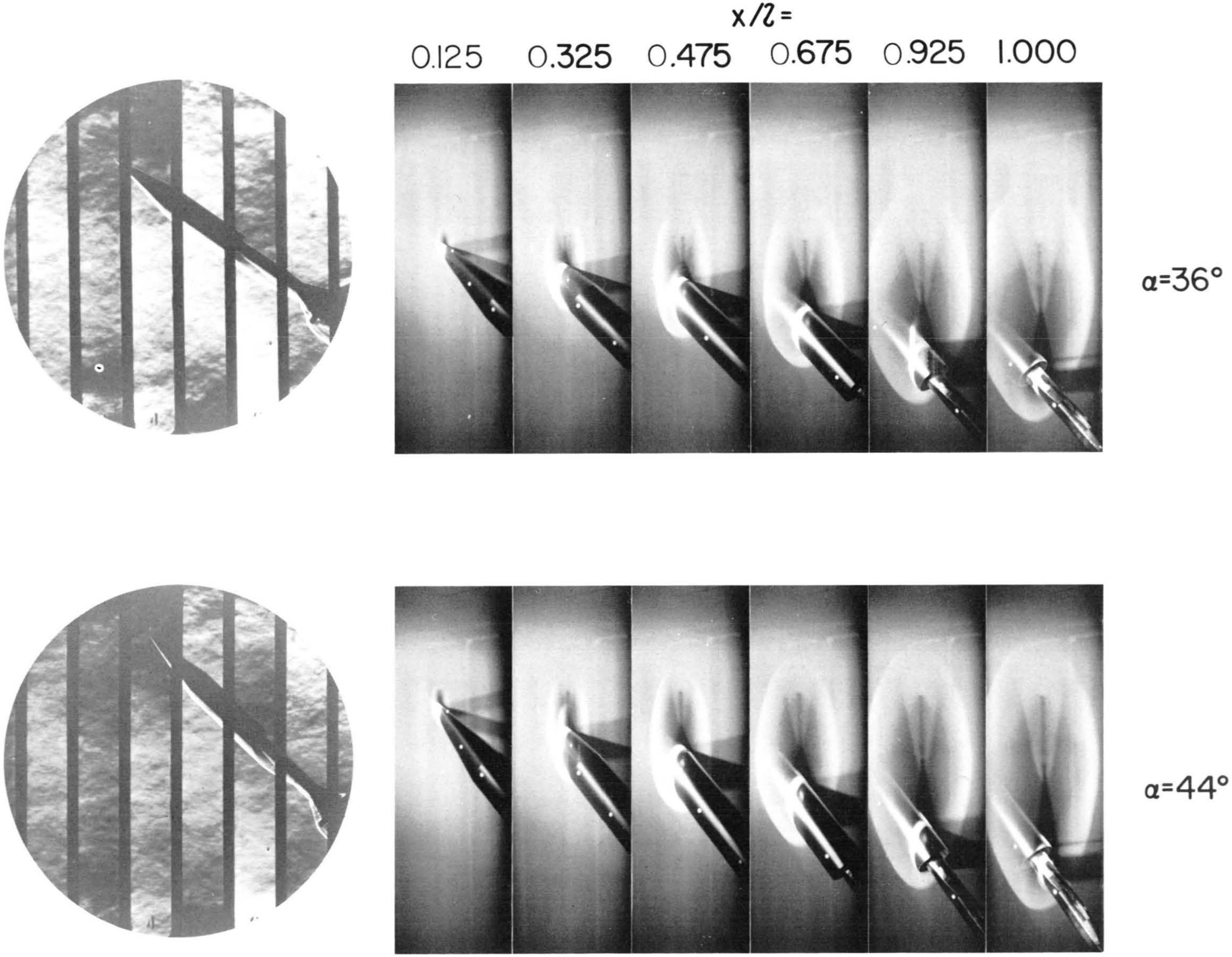
(d) $M_{\infty} = 4.63$.

Figure 1.- Continued.



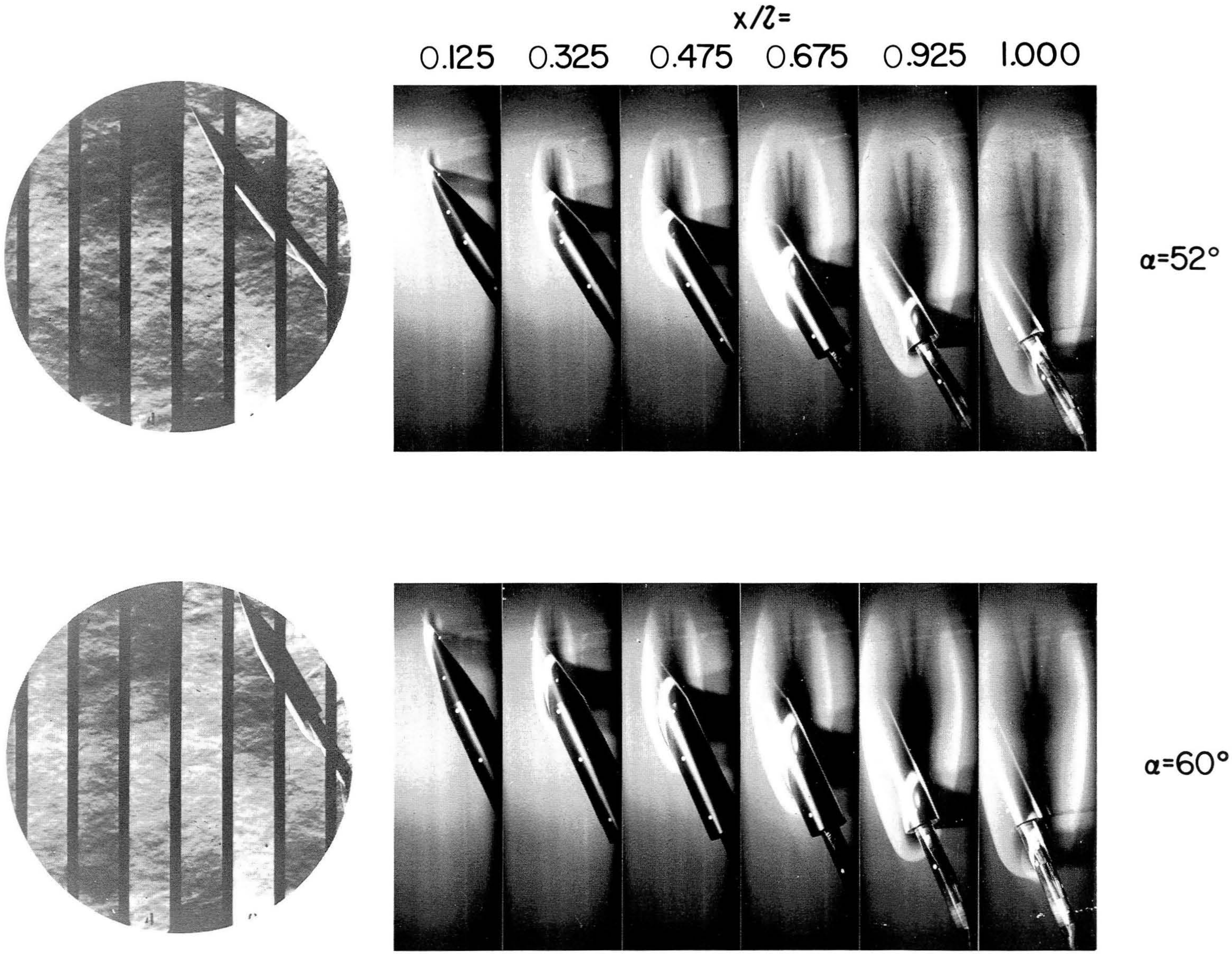
(d) Continued.

Figure 1.- Continued.



(d) Continued.

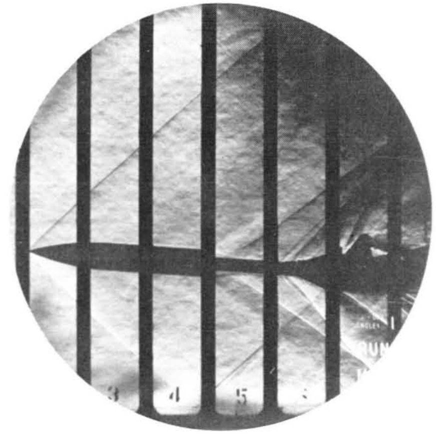
Figure 1.- Continued.



(d) Concluded.

Figure 1.- Concluded.

α=0°



α=4°

α=12°

(a) $M_\infty = 1.6$.

Figure 2.- Schlieren and vapor-screen photographs for circular-arc—cylinder model.

$\alpha = 20°$ $\alpha = 28°$

$\alpha = 36°$ $\alpha = 44°$

(a) Concluded.

Figure 2.- Continued.

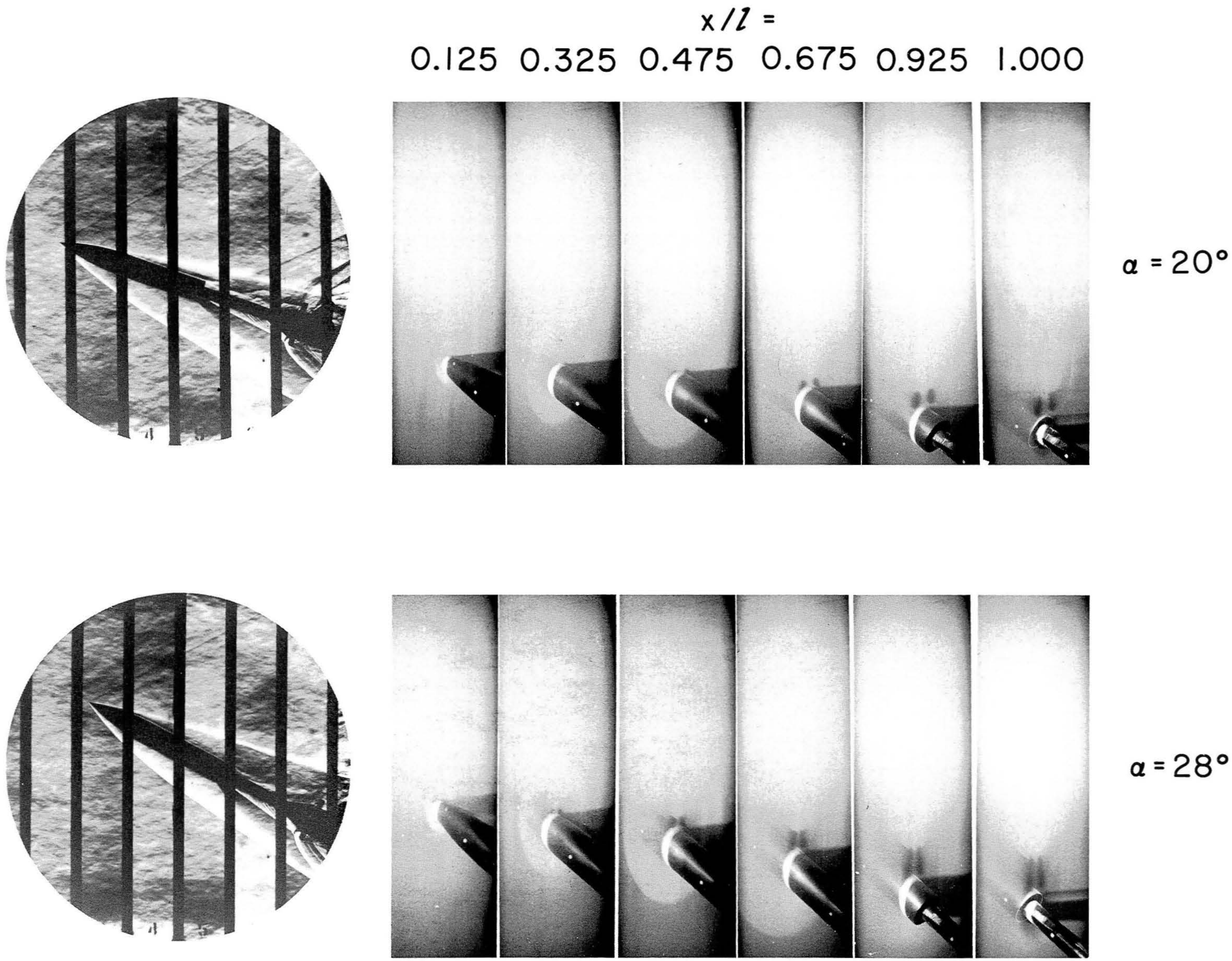
$\alpha = 0°$

$\alpha = 4°$

$\alpha = 12°$

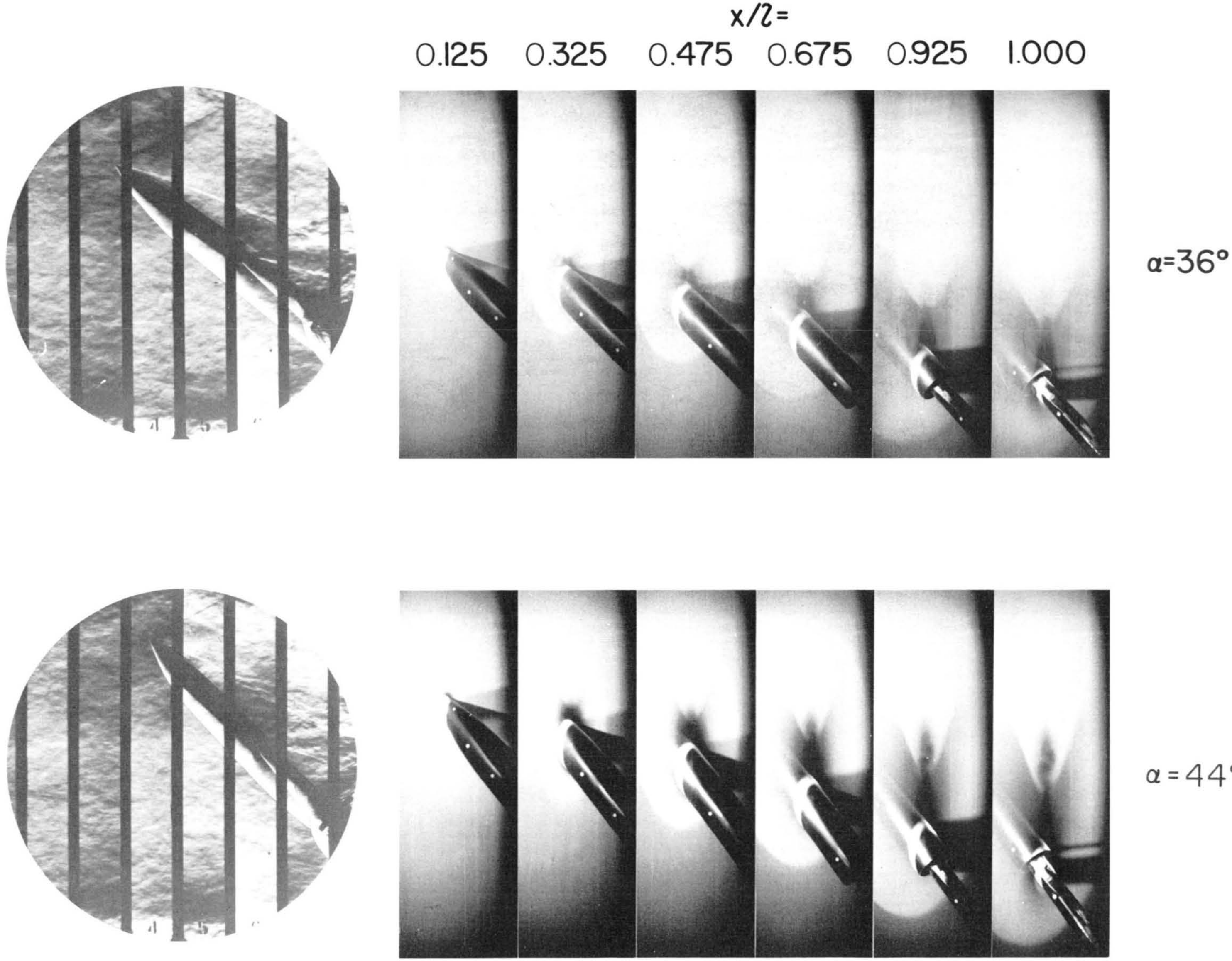
(b) $M_\infty = 2.3$.

Figure 2.- Continued.



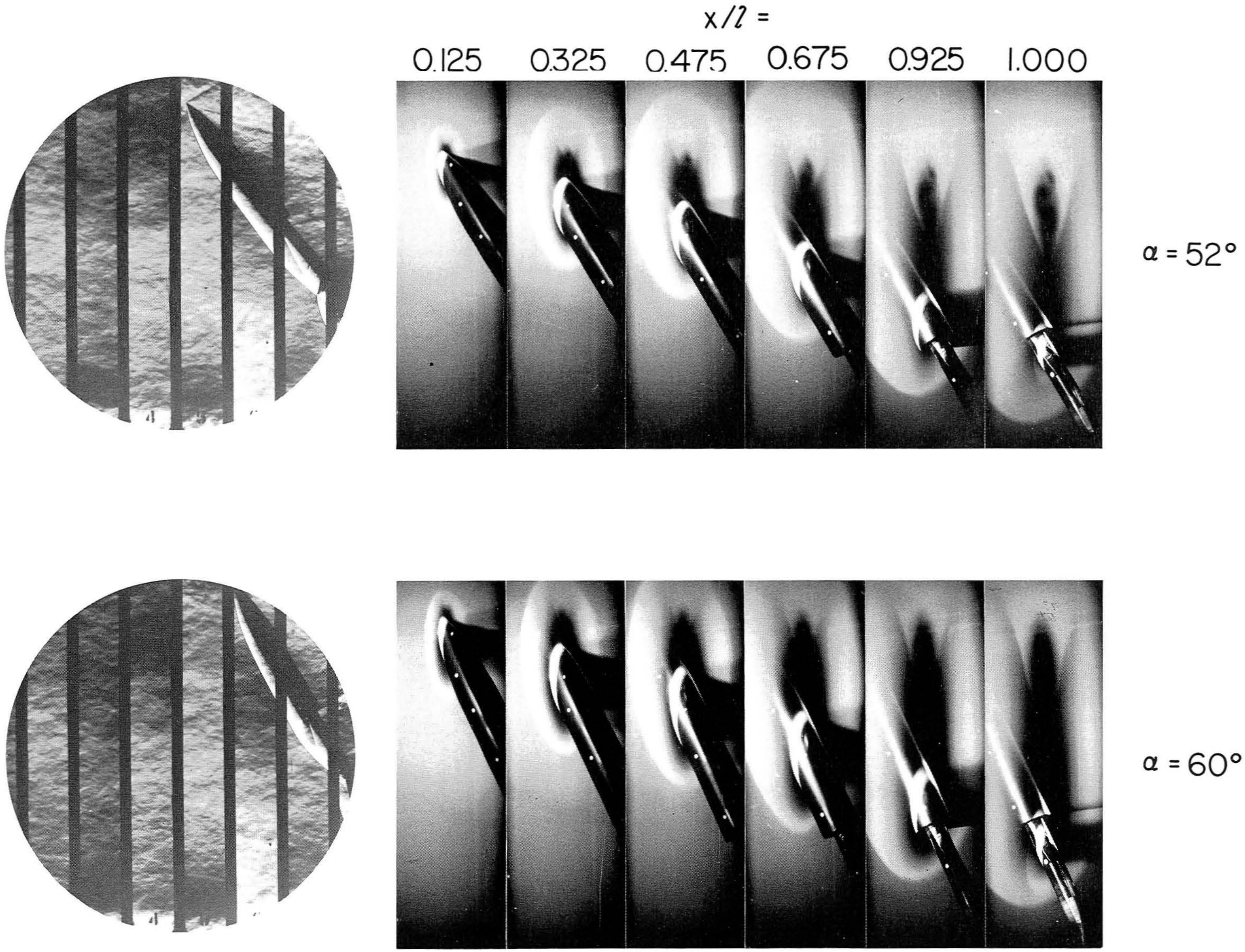
(b) Continued.

Figure 2.- Continued.



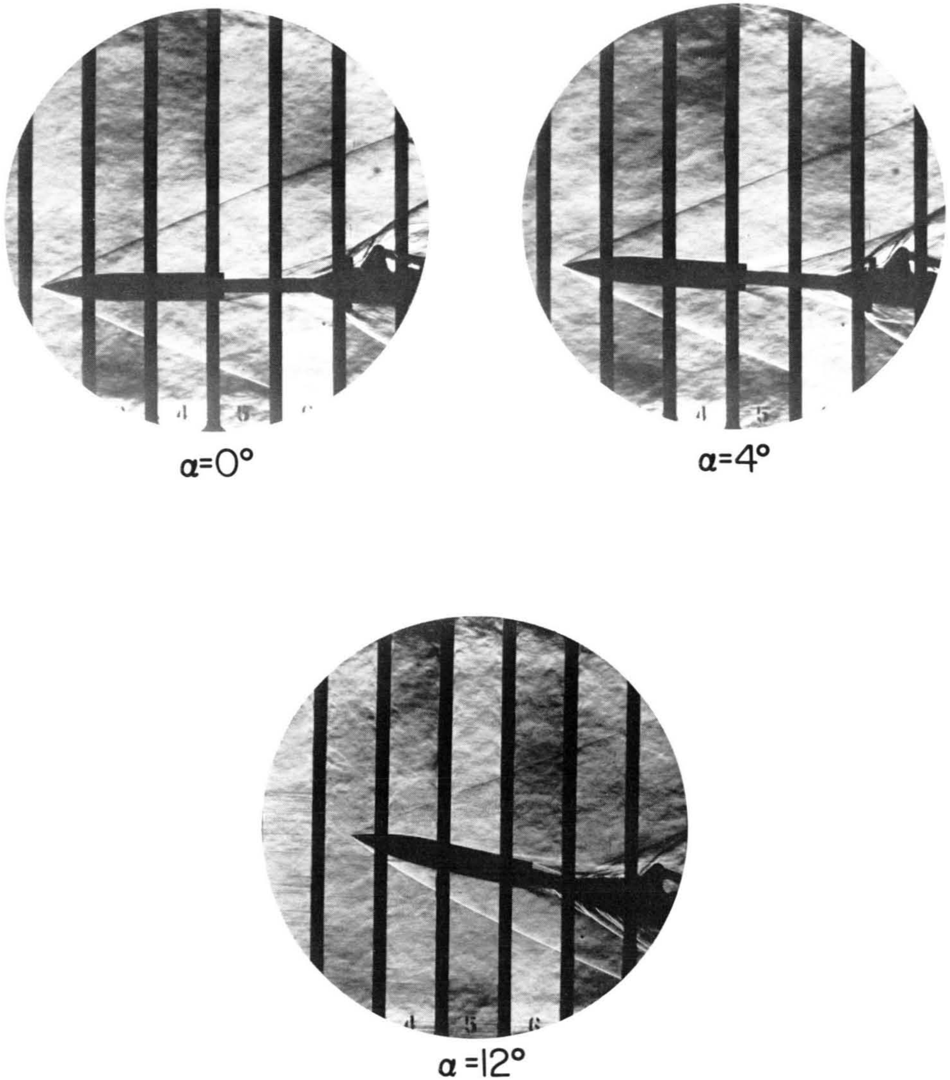
(b) Continued.

Figure 2.- Continued.



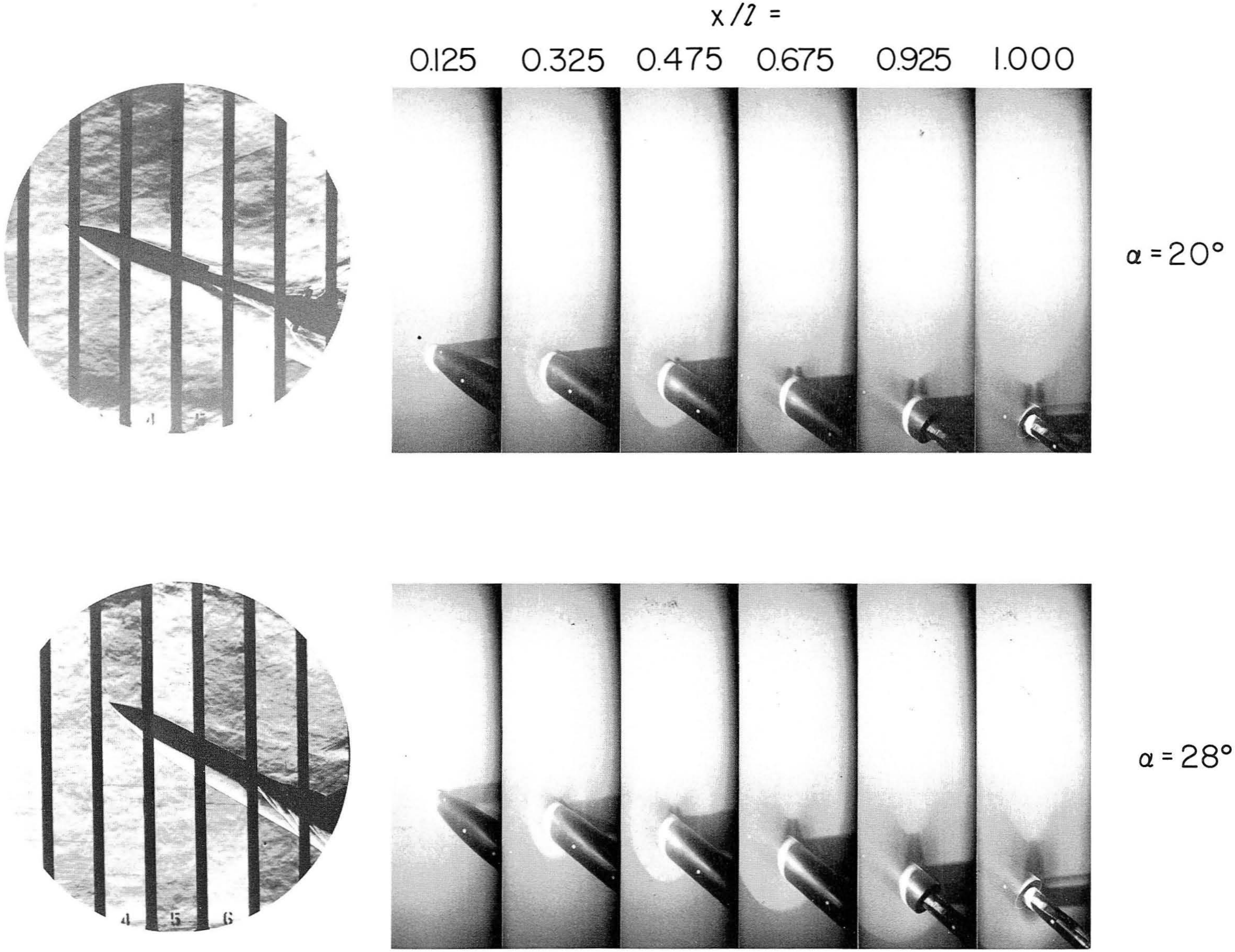
(b) Concluded.

Figure 2.- Continued.



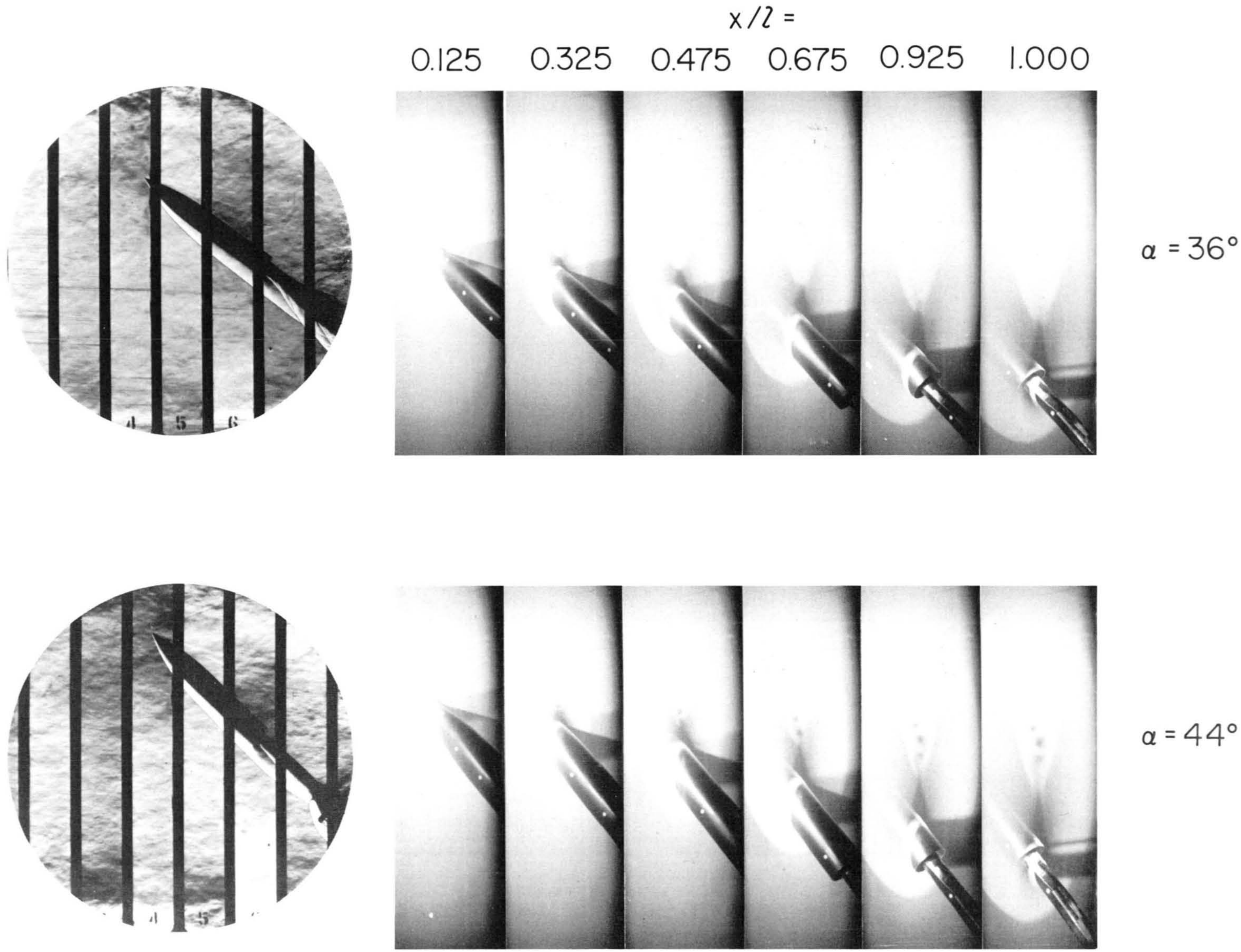
(c) M_∞ = 2.96.

Figure 2.- Continued.



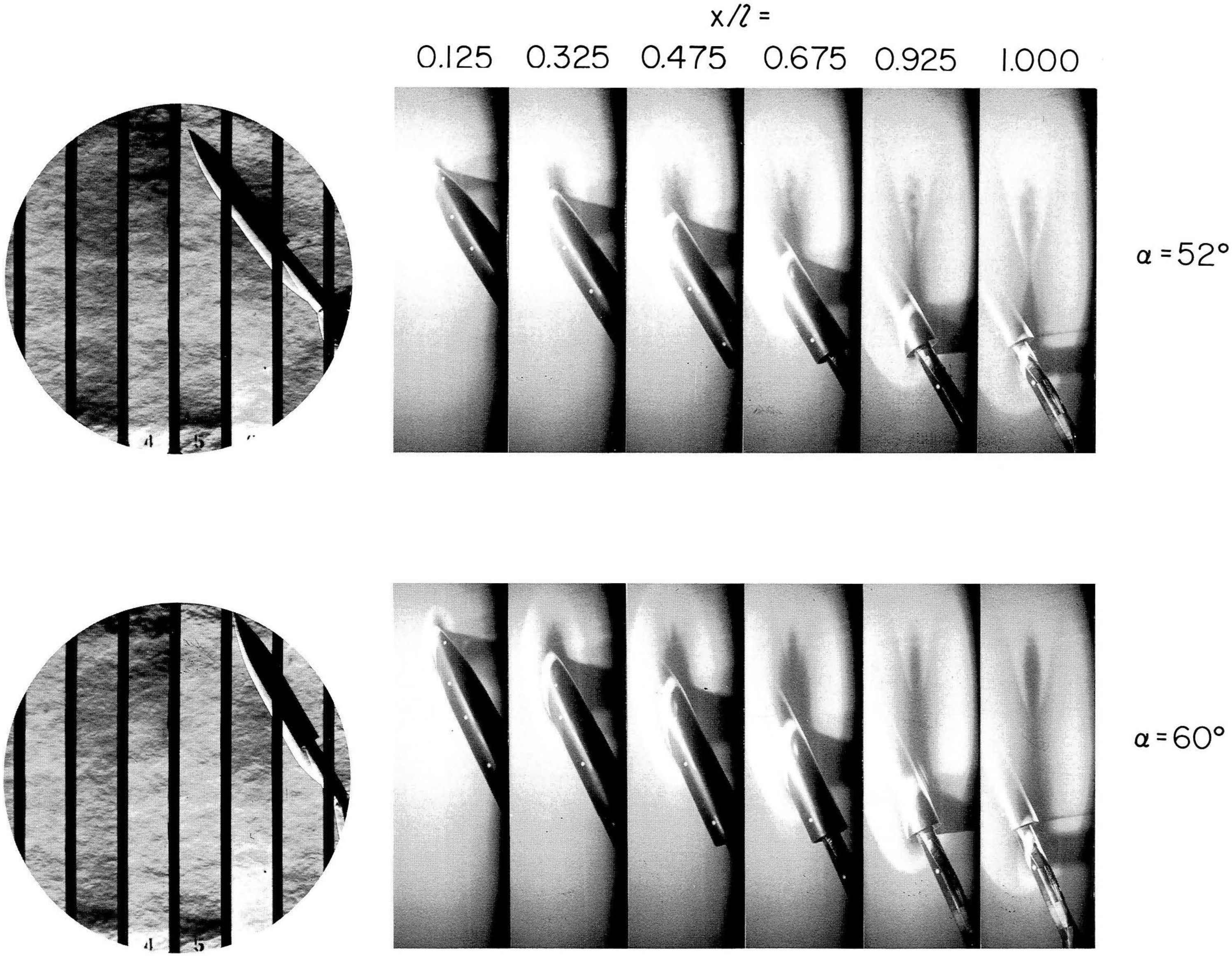
(c) Continued.

Figure 2.- Continued.



(c) Continued.

Figure 2.- Continued.



(c) Concluded.

Figure 2.- Continued.

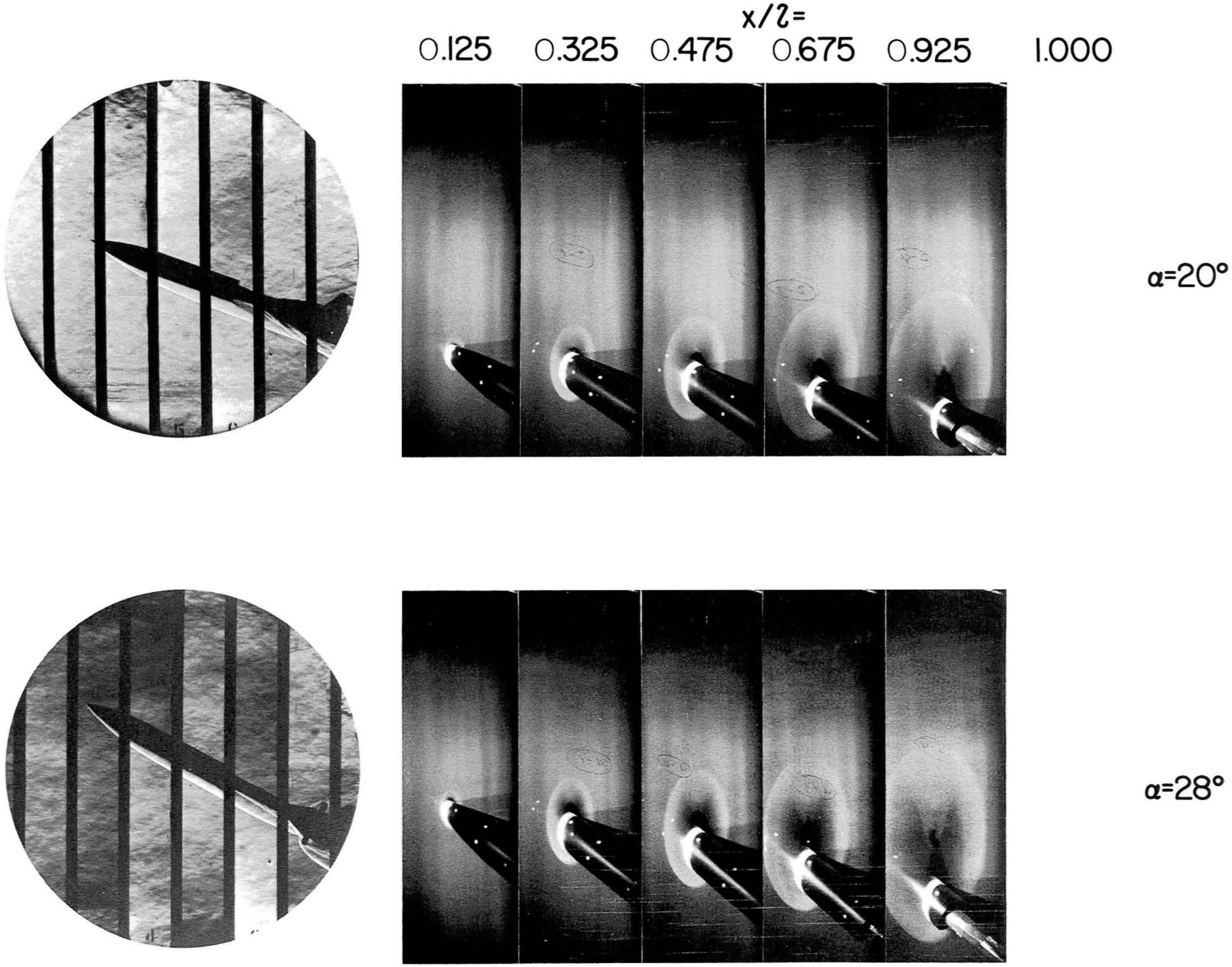
$\alpha = 0°$

$\alpha = 4°$

$\alpha = 12°$

(d) $M_\infty = 4.63$.

Figure 2.- Continued.

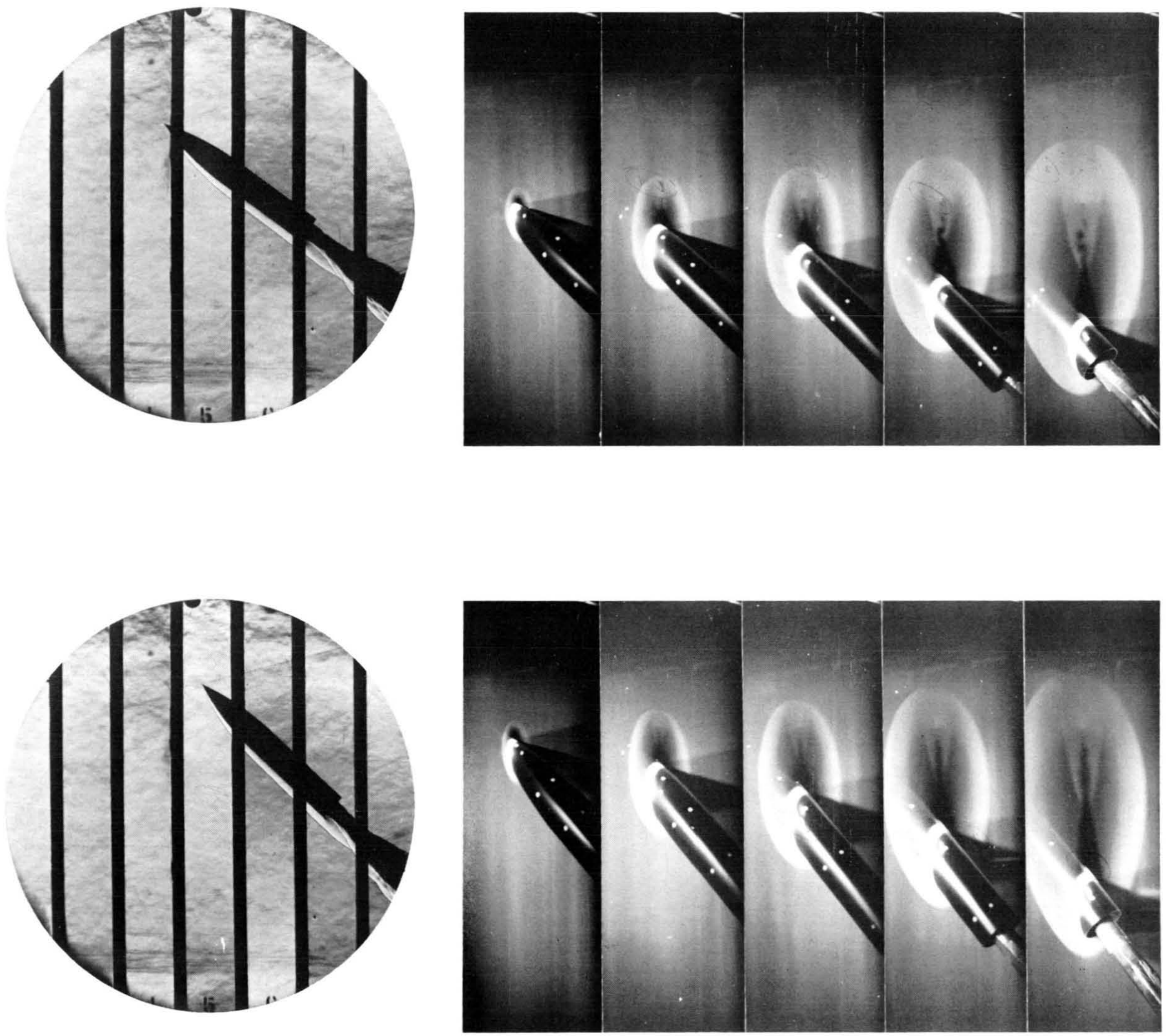


(d) Continued.

Figure 2.- Continued.

$x/l =$

0.125 0.325 0.475 0.675 0.925 1.000

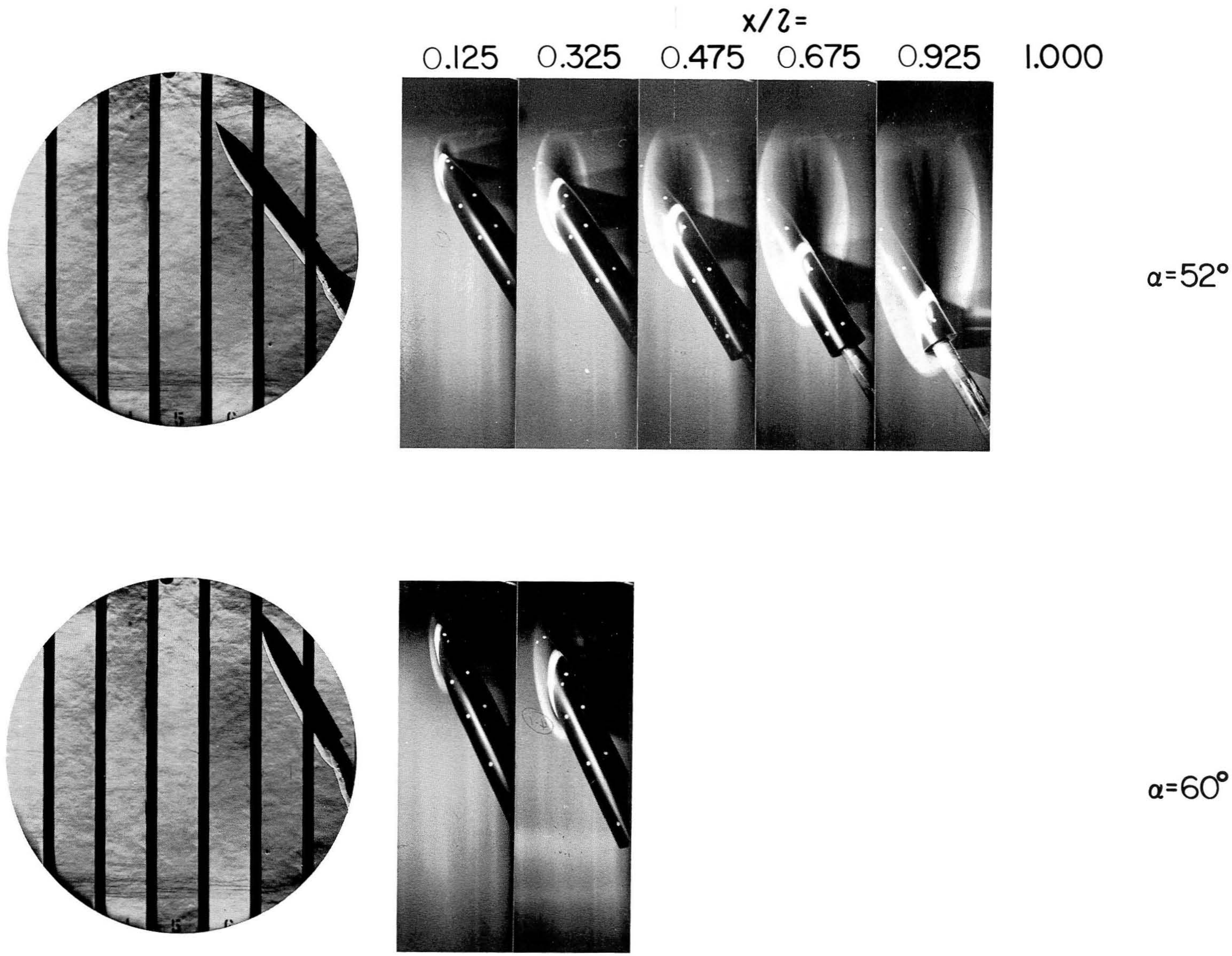


$\alpha = 36°$

$\alpha = 44°$

(d) Continued.

Figure 2.- Continued.

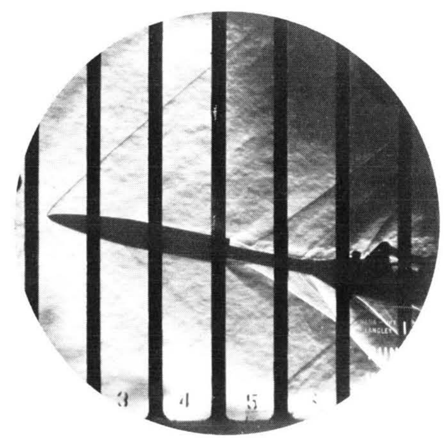


(d) Concluded.

Figure 2.- Concluded.

$\alpha=0°$

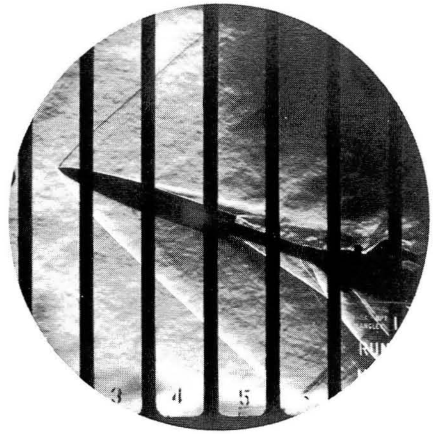
$\alpha=4°$



$\alpha=12°$

(a) $M_{\infty} = 1.6$.

Figure 3.- Schlieren and vapor-screen photographs for blunt-nose—cylinder model.



α=20°

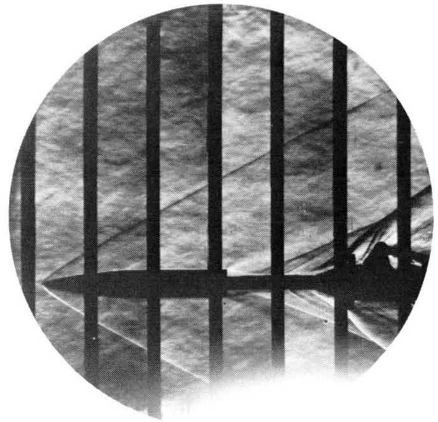
α=28°

α=36°

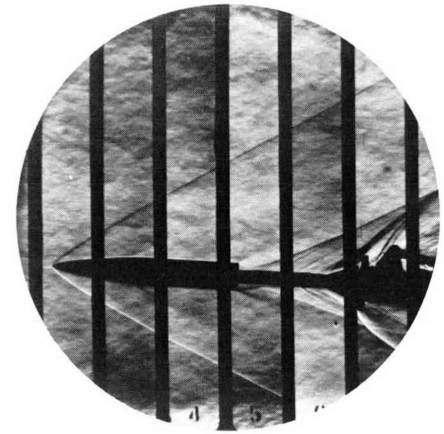
α=44°

(a) Concluded.

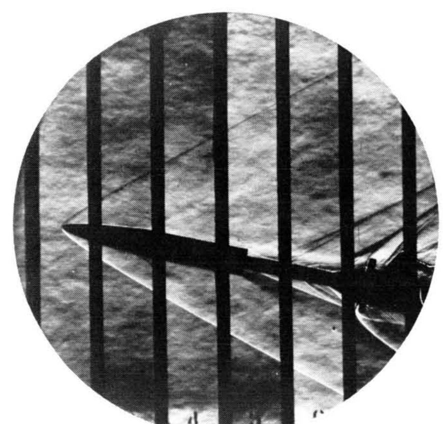
Figure 3.- Continued.



α=0°



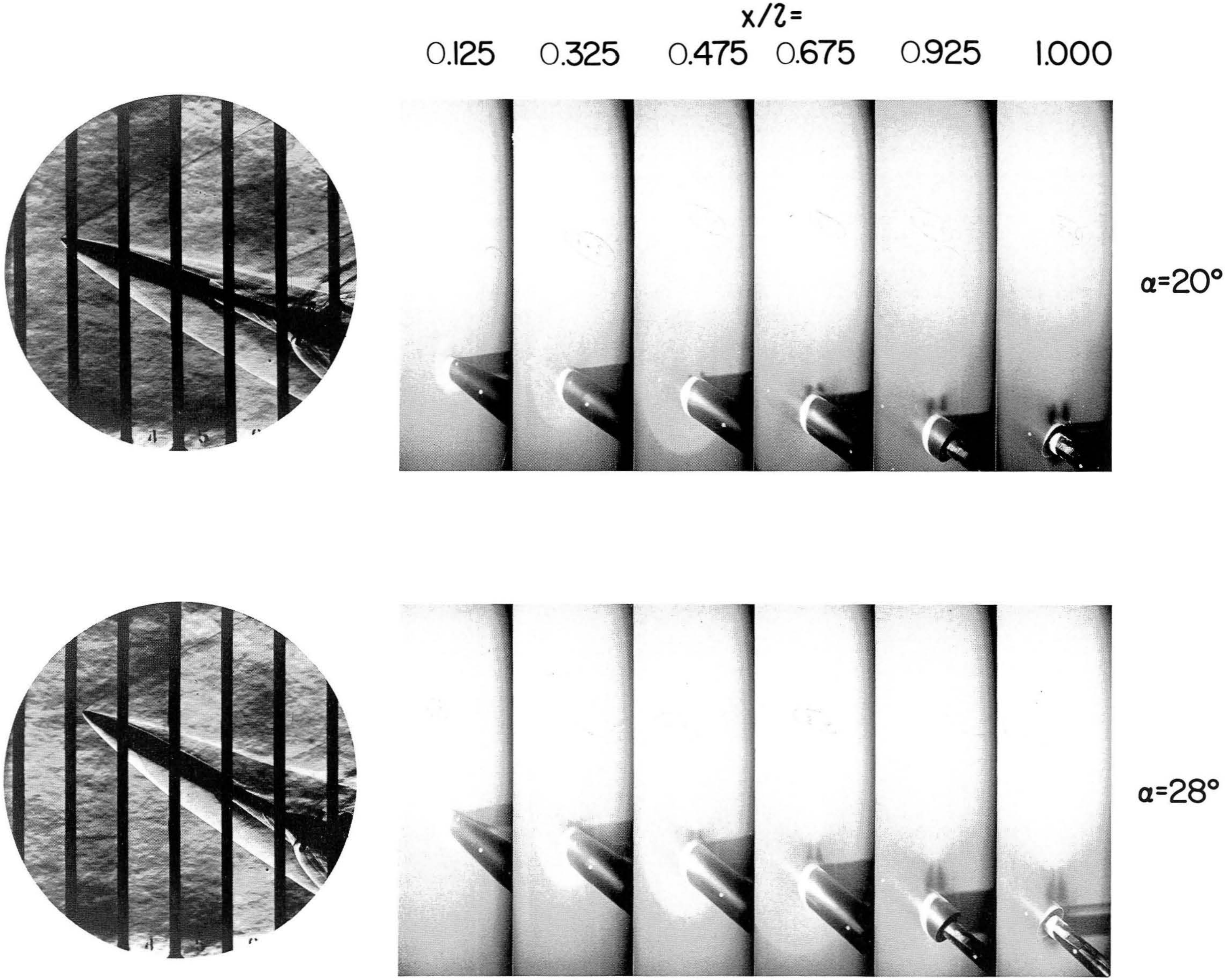
α=4°



α=12°

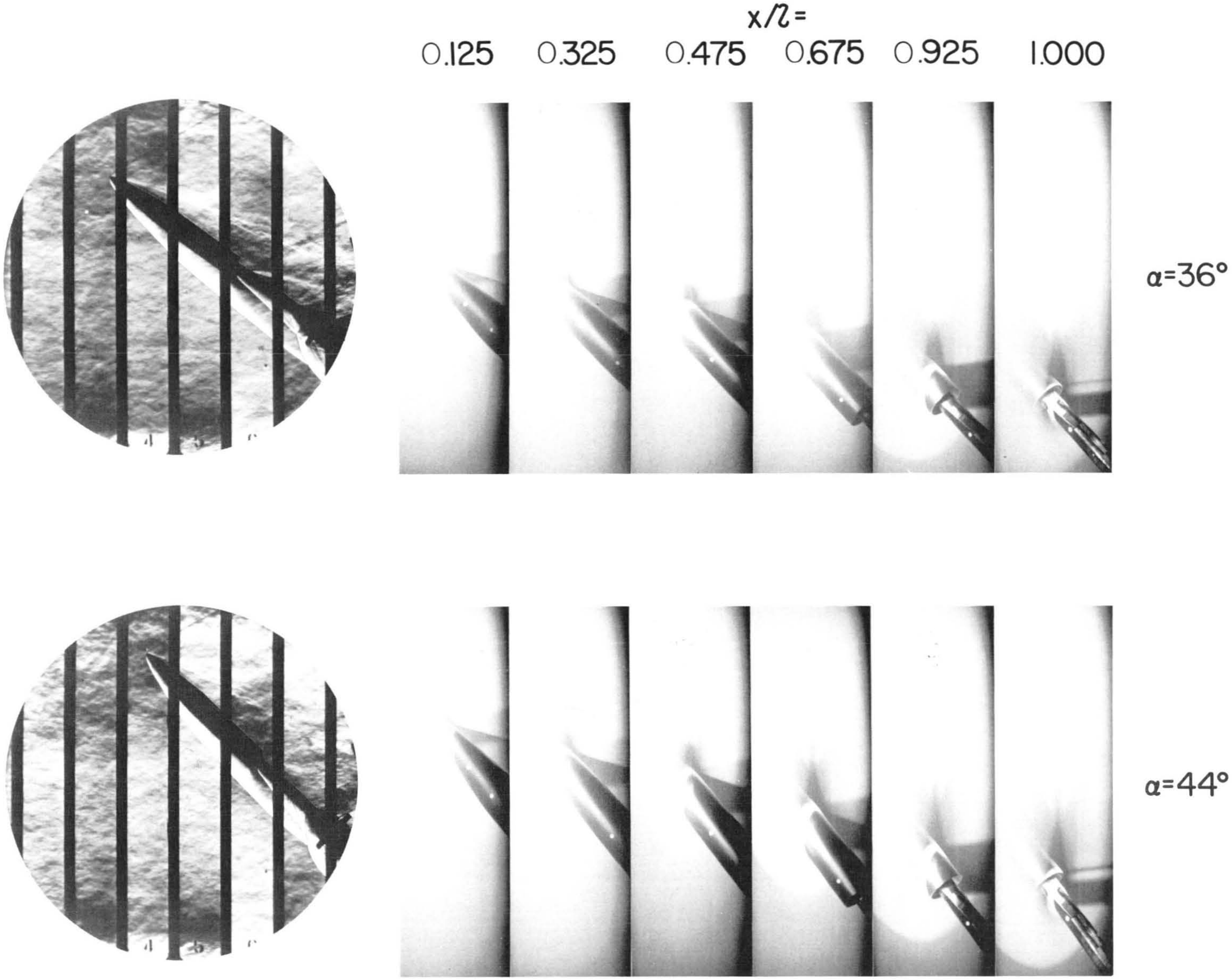
(b) $M_\infty = 2.3$.

Figure 3.- Continued.



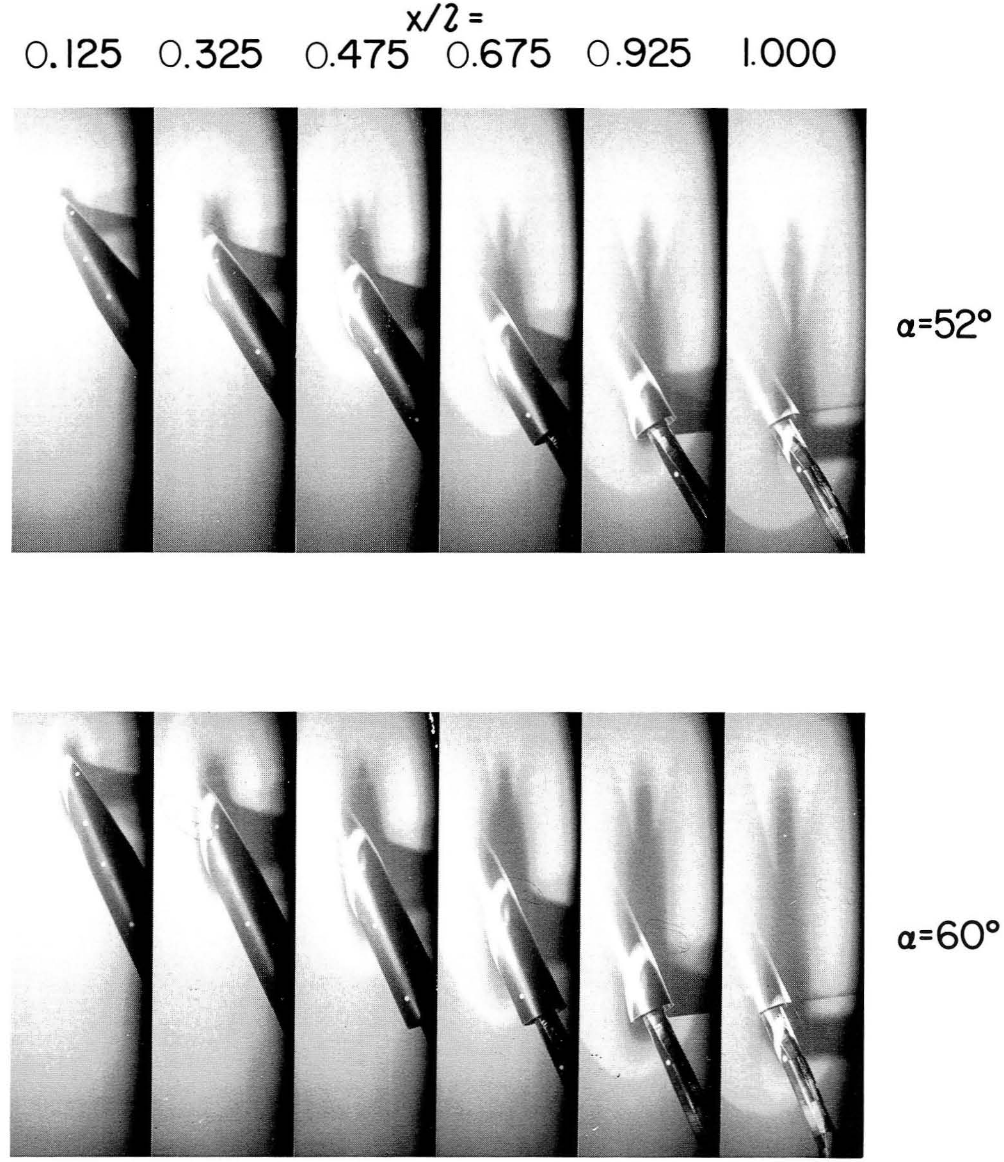
(b) Continued.

Figure 3.- Continued.



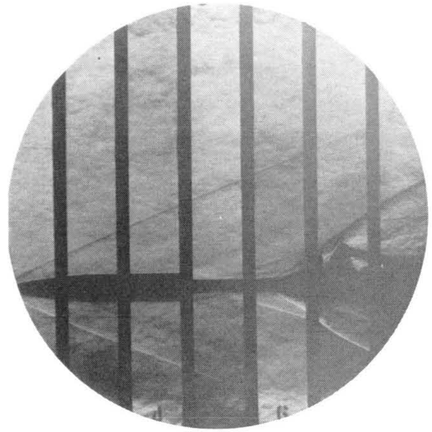
(b) Continued.

Figure 3.- Continued.

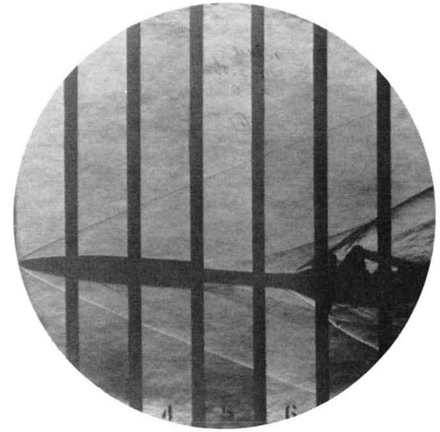


(b) Concluded.

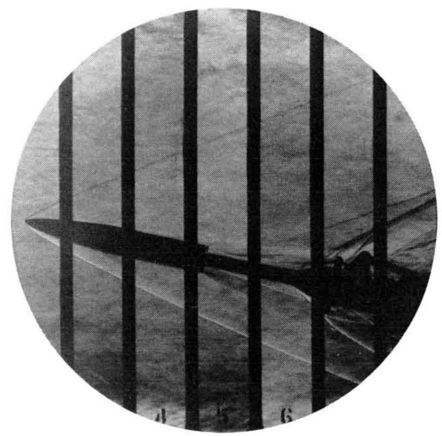
Figure 3.- Continued.



α=0°



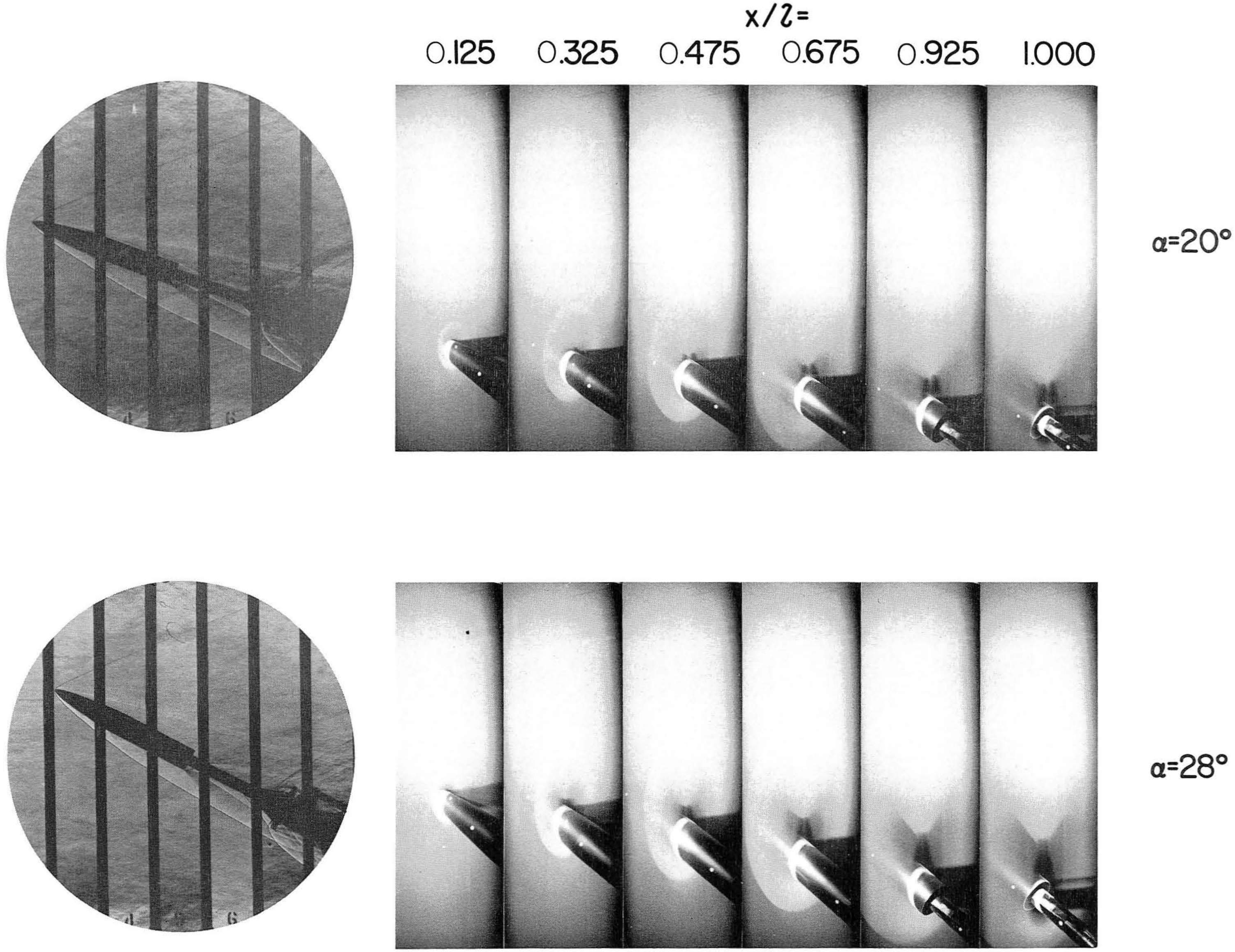
α=4°



α =12°

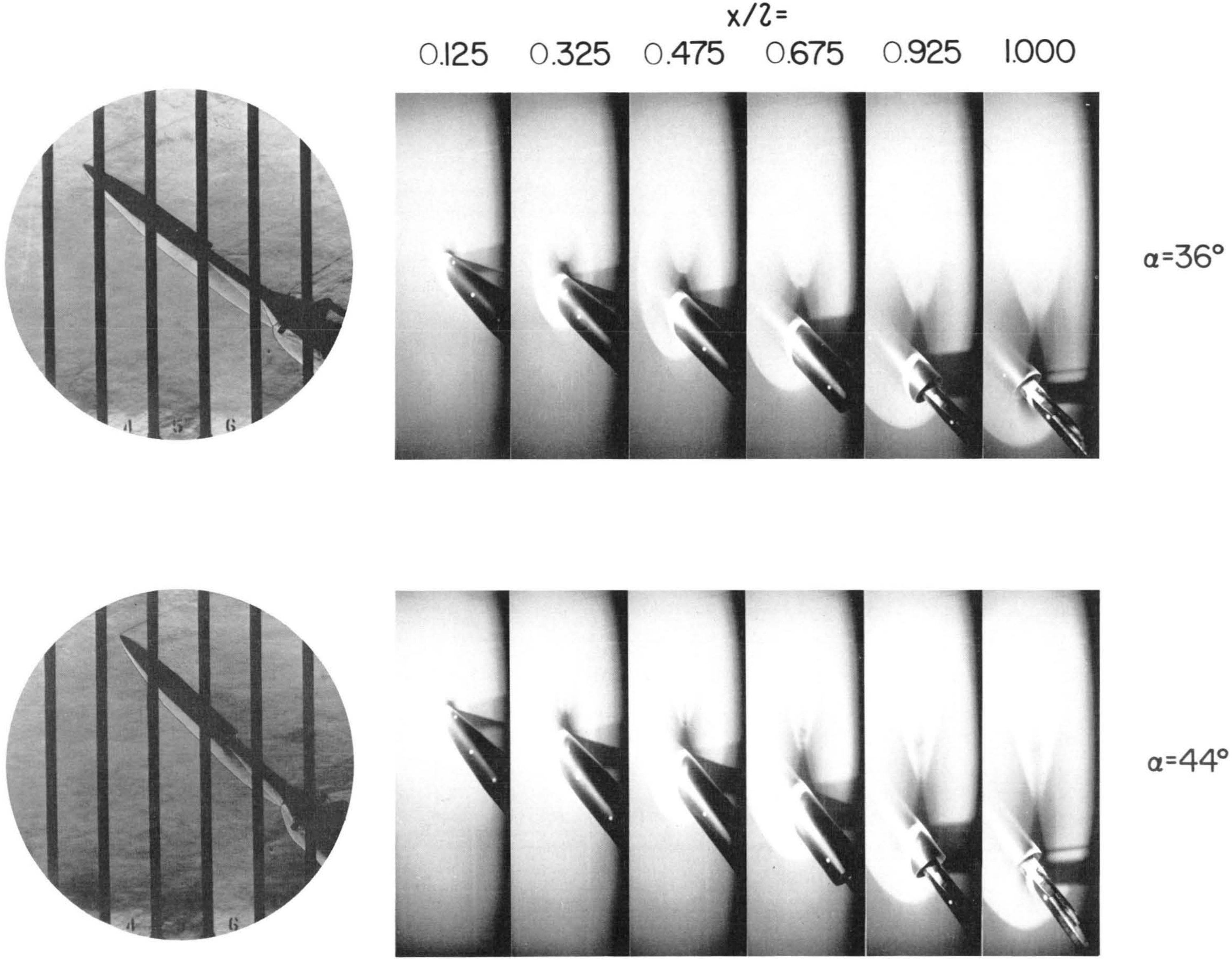
(c) M_{∞} = 2.96.

Figure 3.- Continued.



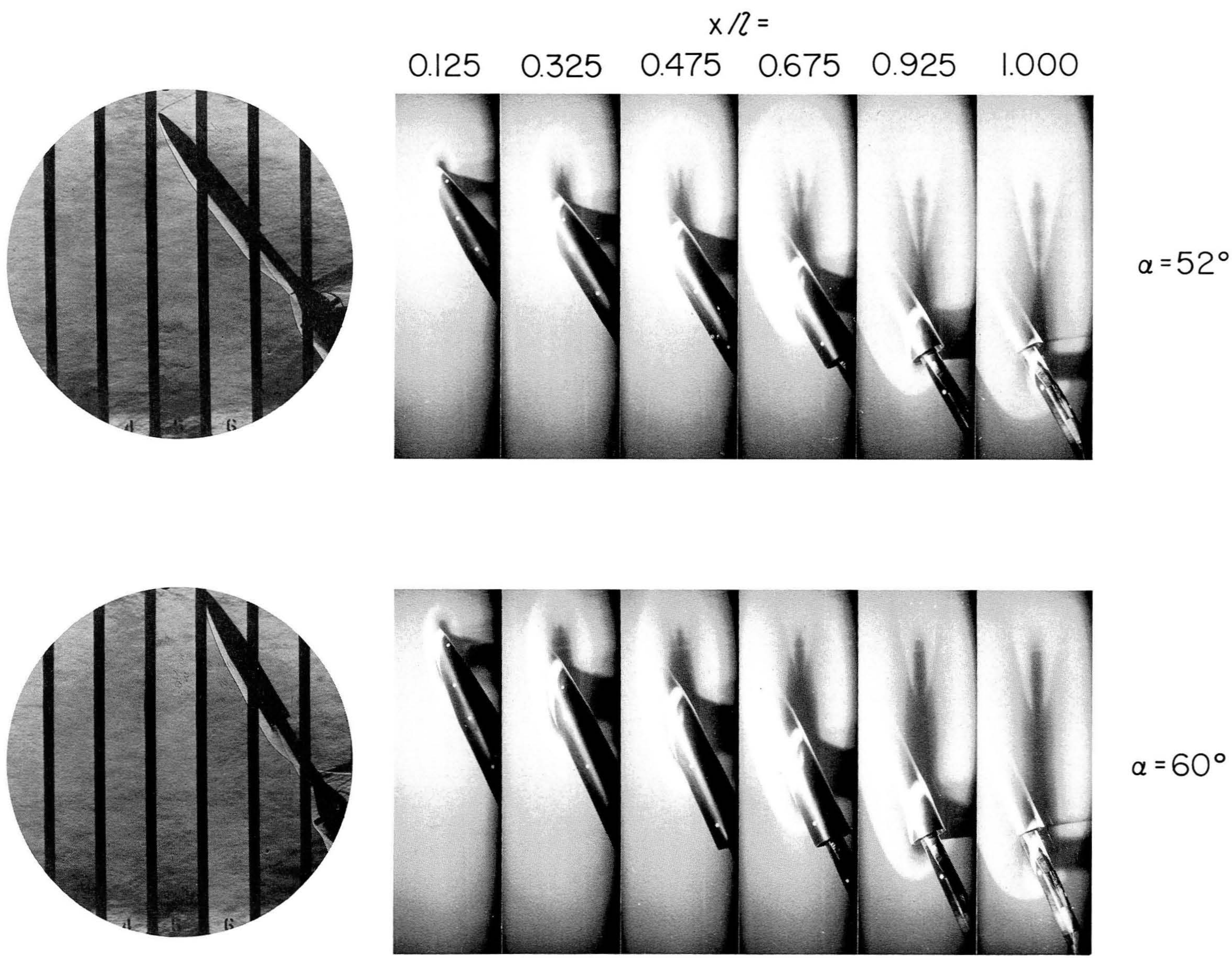
(c) Continued.

Figure 3.- Continued.



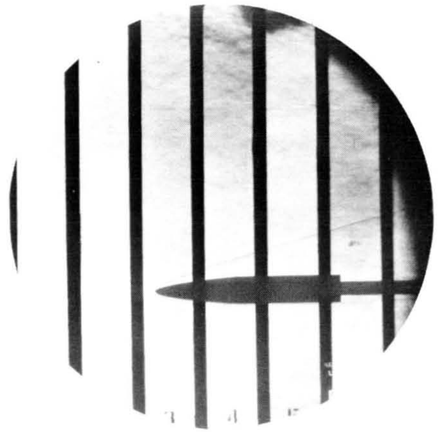
(c) Continued.

Figure 3.- Continued.



(c) Concluded.

Figure 3.- Continued.



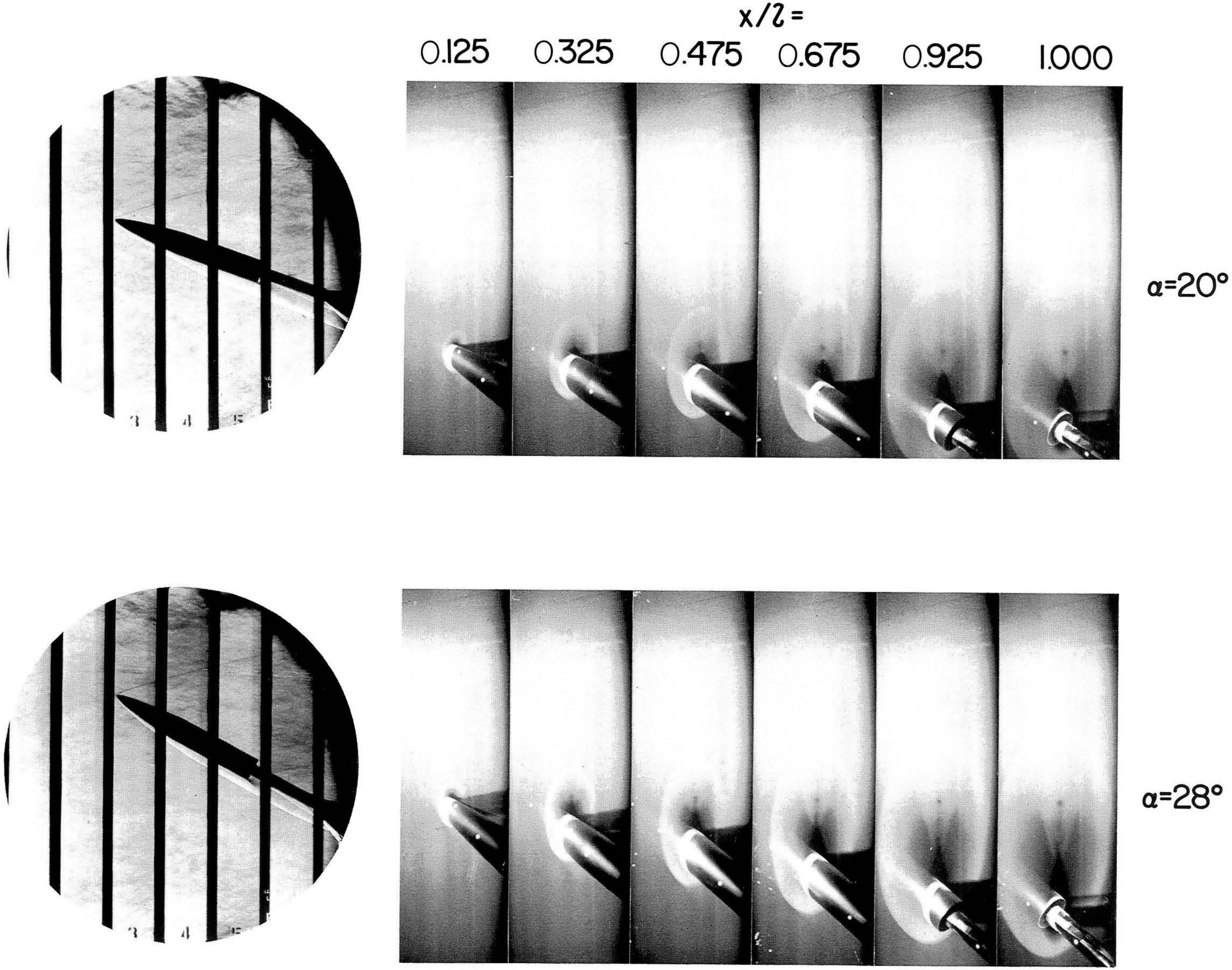
$\alpha = 0°$

$\alpha = 4°$

$\alpha = 12°$

(d) $M_\infty = 4.63$.

Figure 3.- Continued.

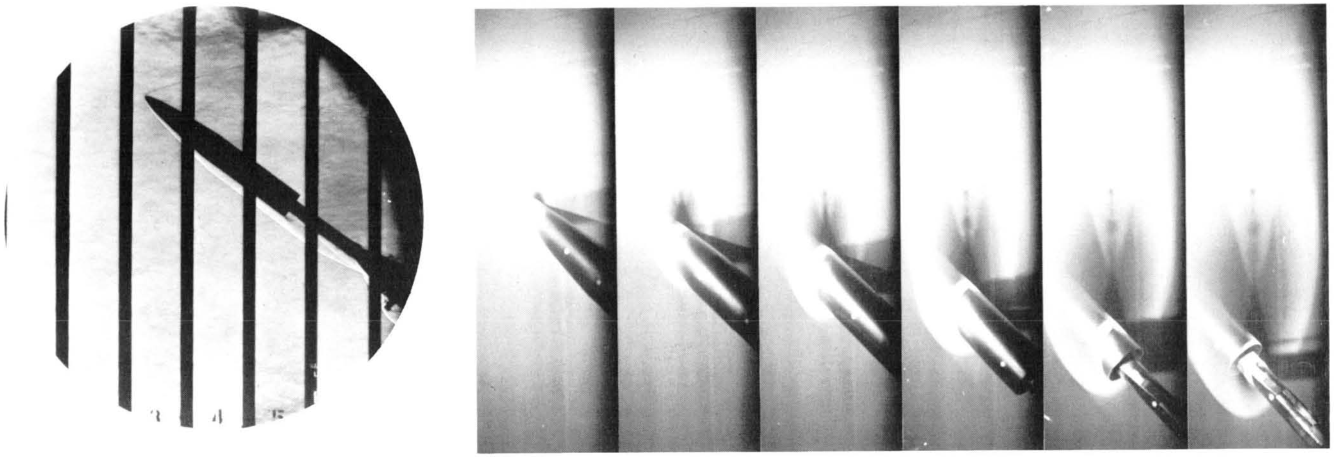


(d) Continued.

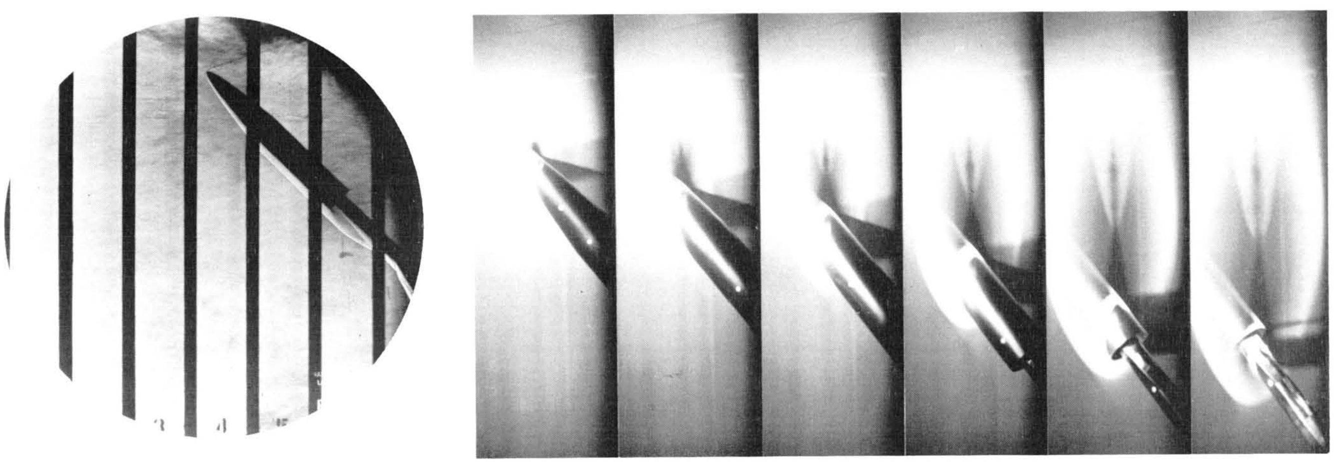
Figure 3.- Continued.

$x/l =$

0.125 0.325 0.475 0.675 0.925 1.000



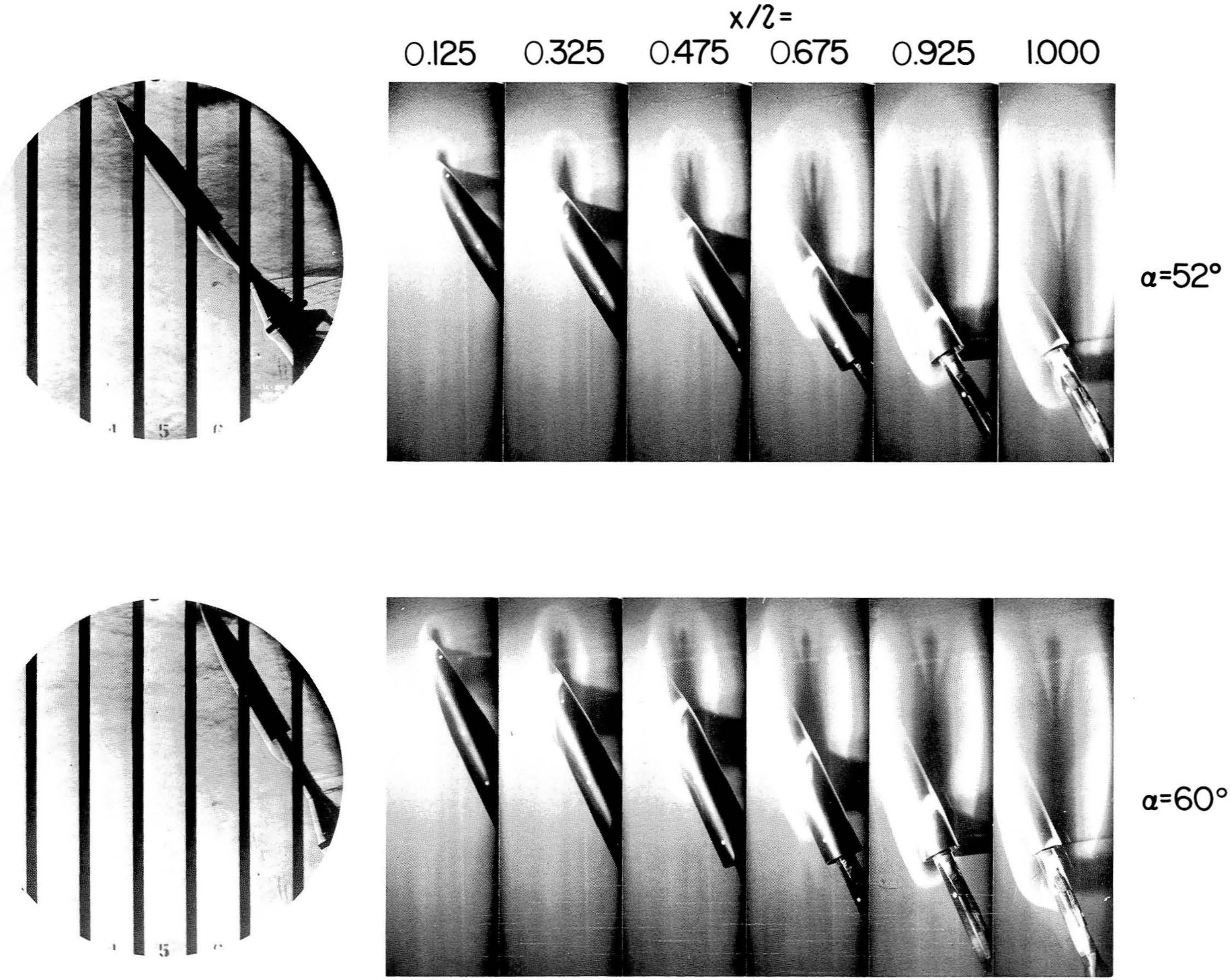
$\alpha = 36°$



$\alpha = 44°$

(d) Continued.

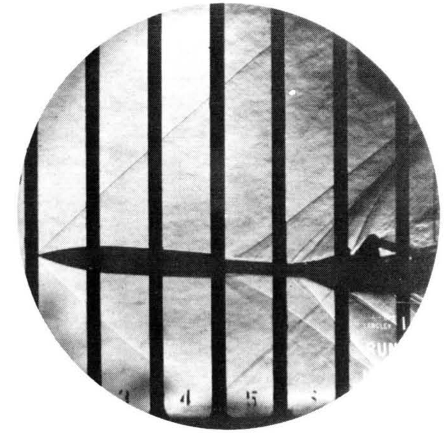
Figure 3.- Continued.



(d) Concluded.

Figure 3.- Concluded.

α=0°



α=4°

α=12°

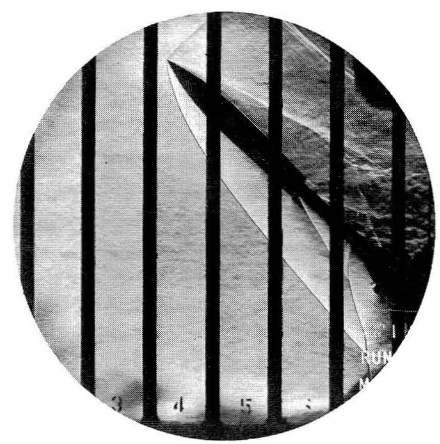
(a) $M_\infty = 1.6$.

Figure 4.- Schlieren and vapor-screen photographs for circular-arc—circular-arc model.

α=20°

α=28°

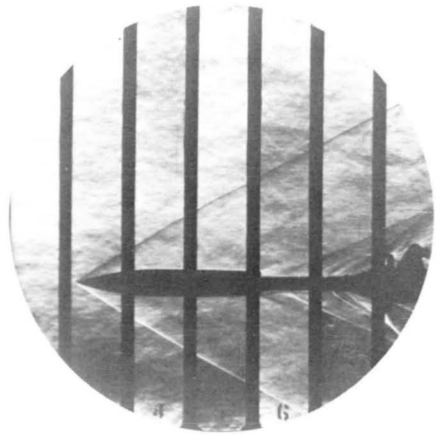
α=36°



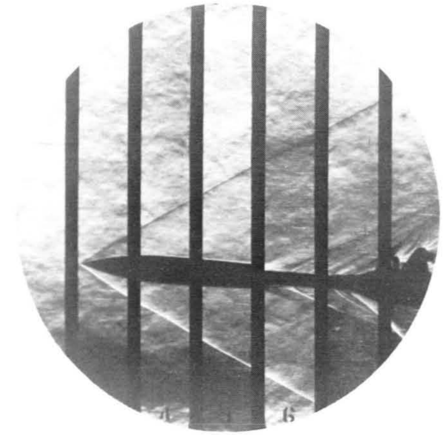
α=44°

(a) Concluded.

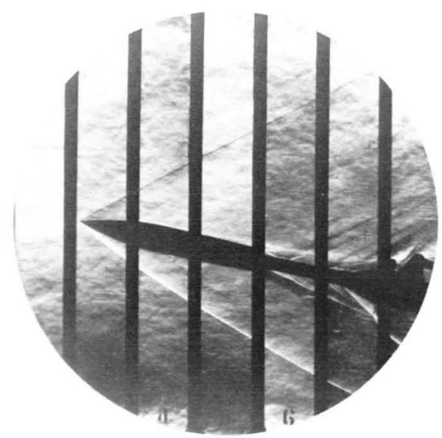
Figure 4.- Continued.



α=0°



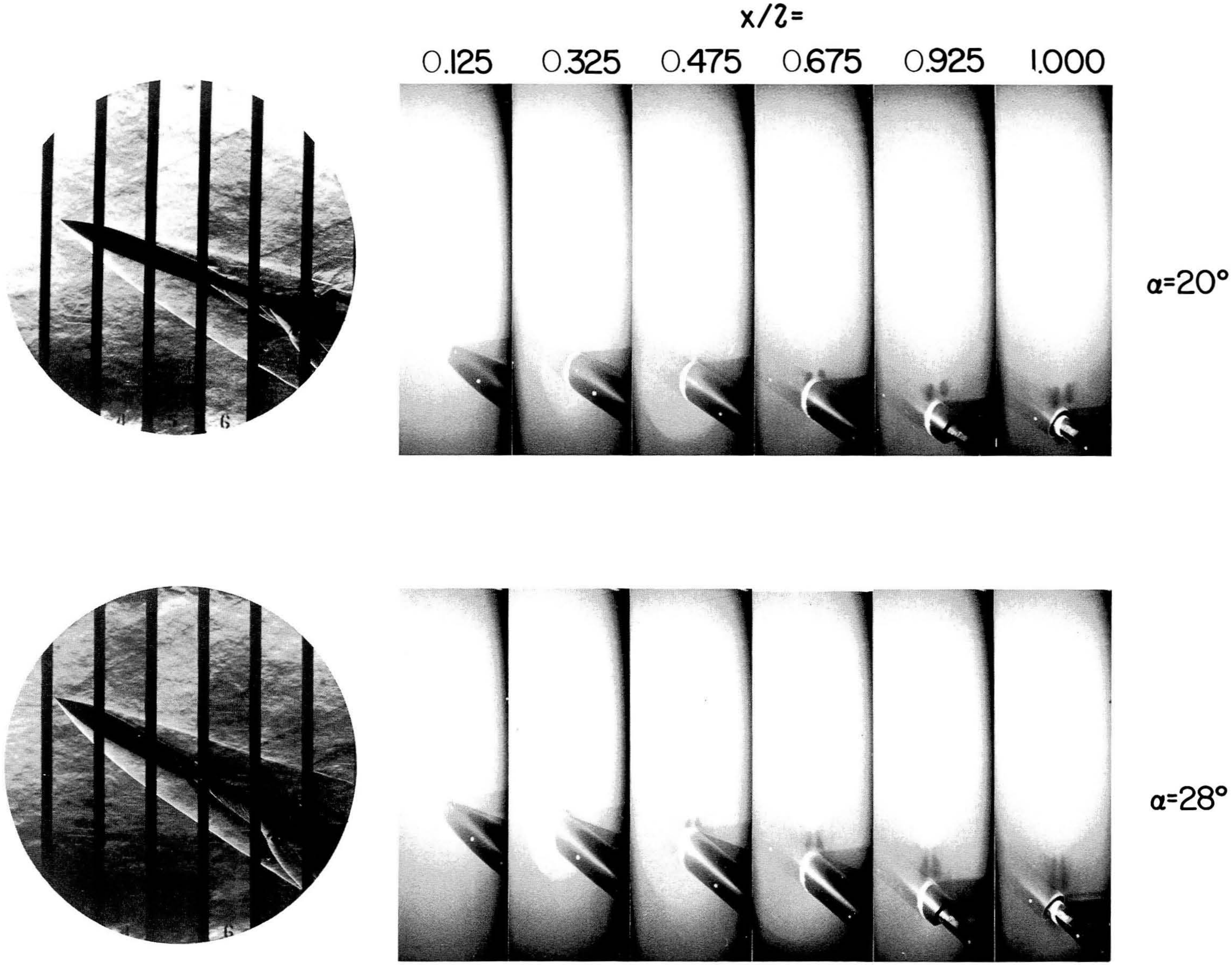
α=4°



α =12°

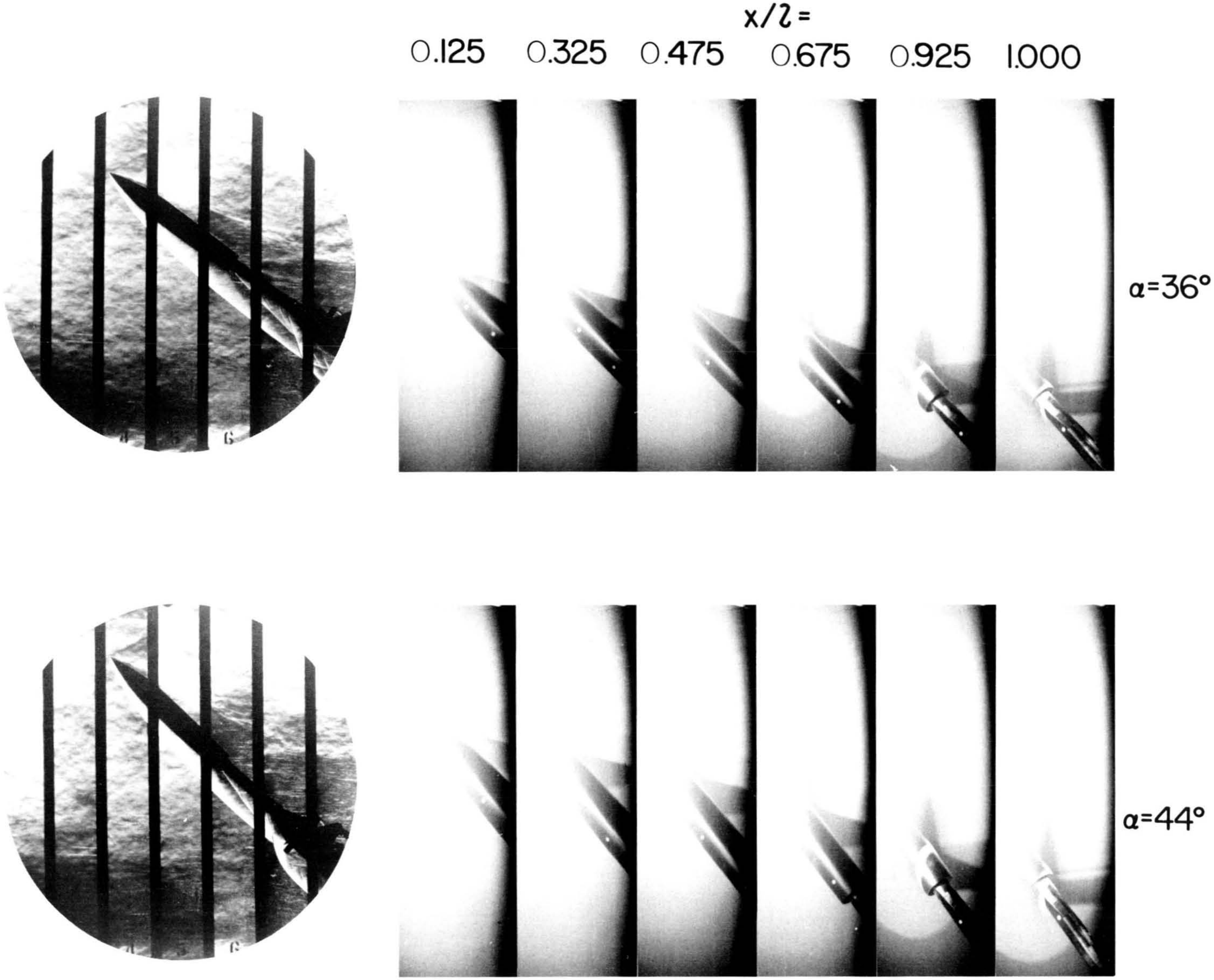
(b) $M_\infty = 2.3$.

Figure 4.- Continued.



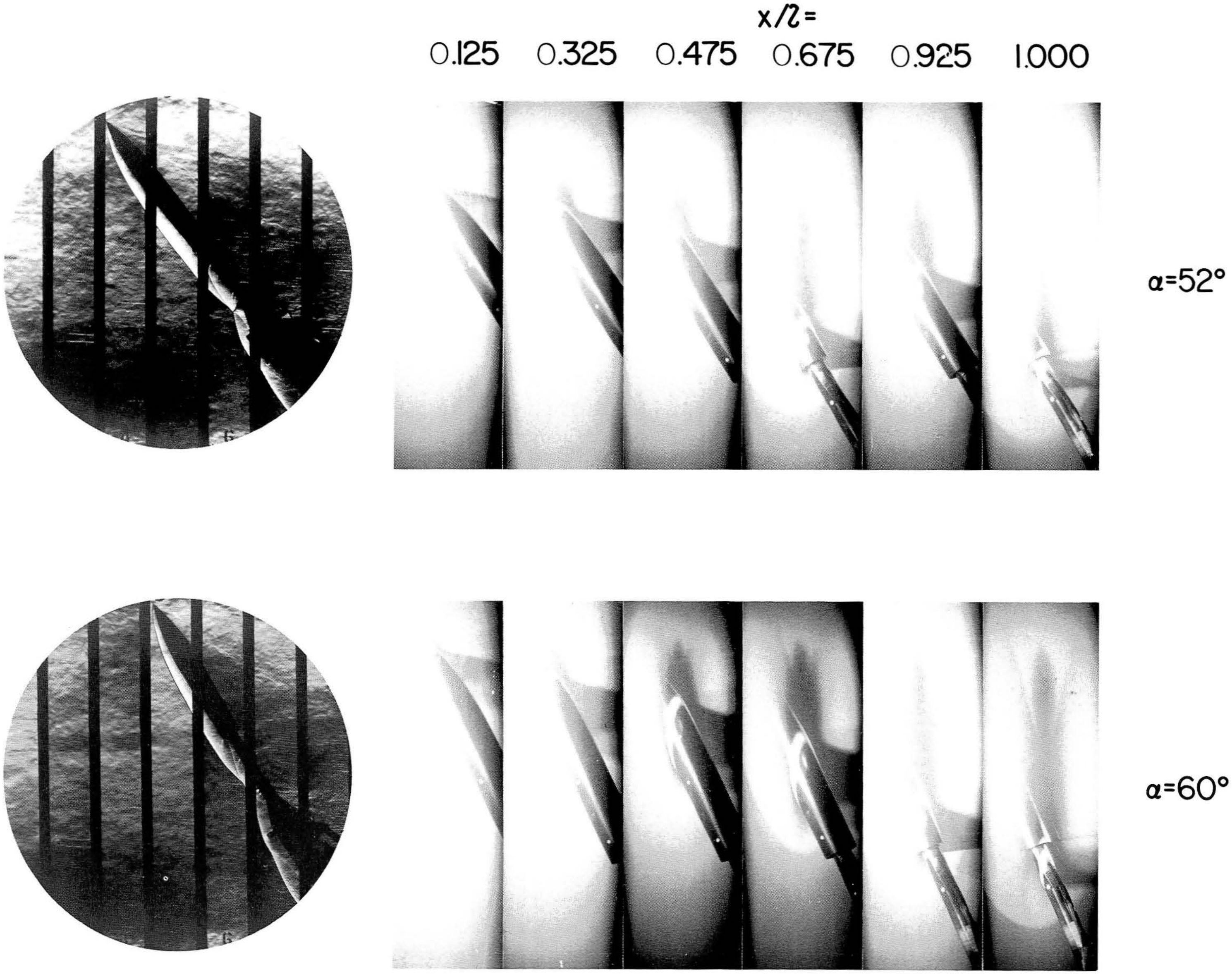
(b) Continued.

Figure 4.- Continued.



(b) Continued.

Figure 4.- Continued.



(b) Concluded.

Figure 4.- Continued.

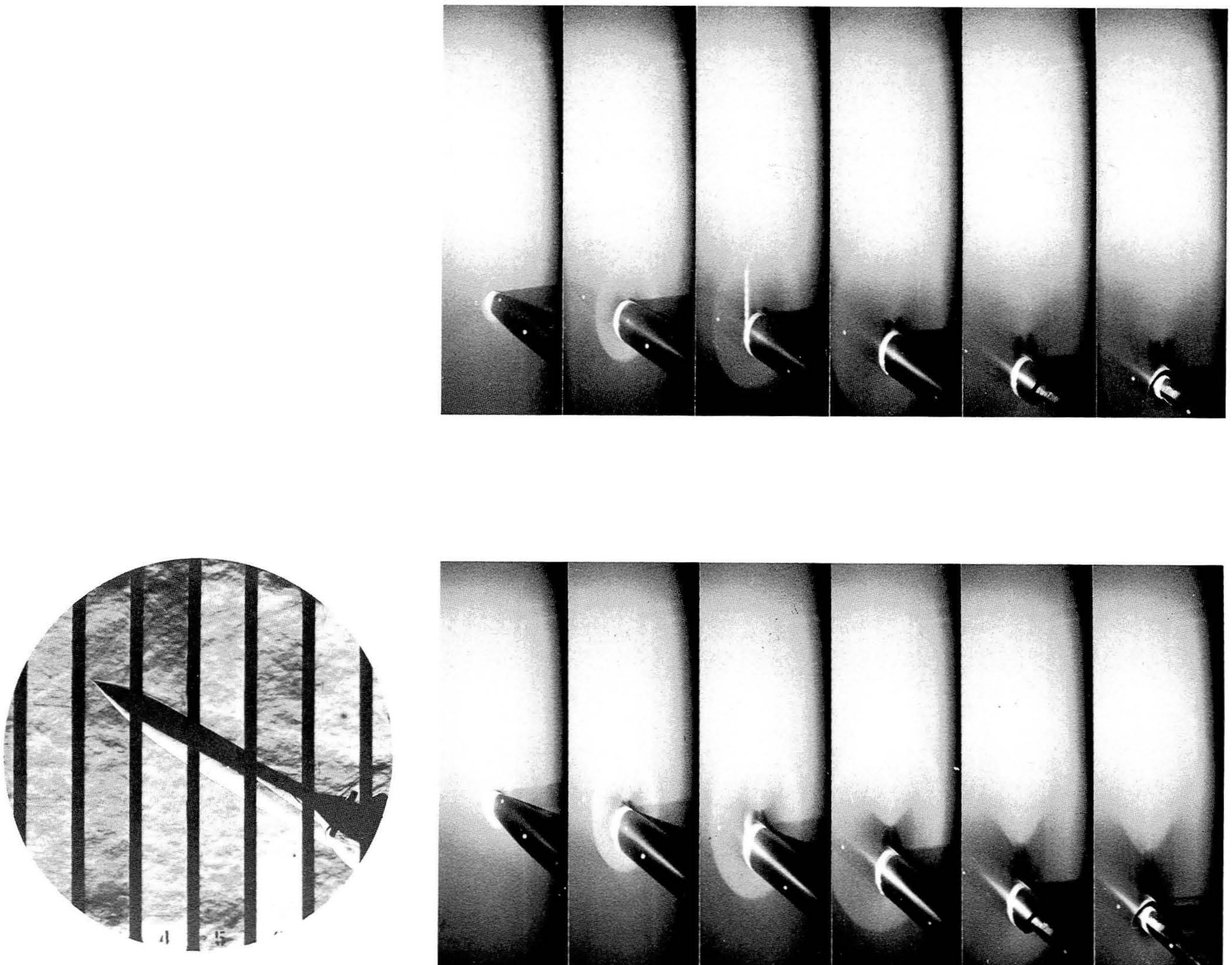
α=0°

α=4°

α=12°

(c) $M_\infty = 2.96$.

Figure 4.- Continued.

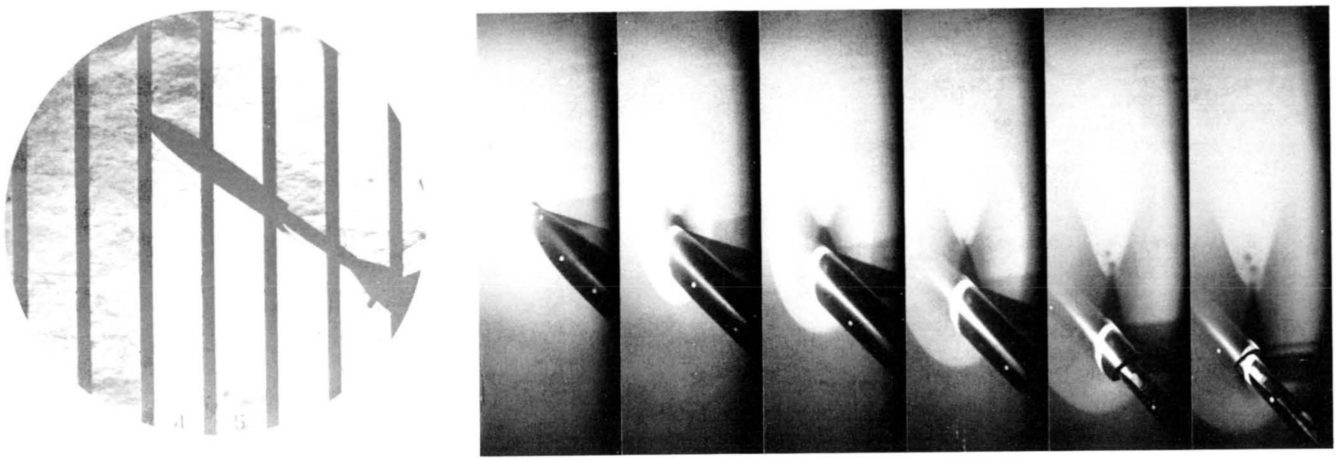


(c) Continued.

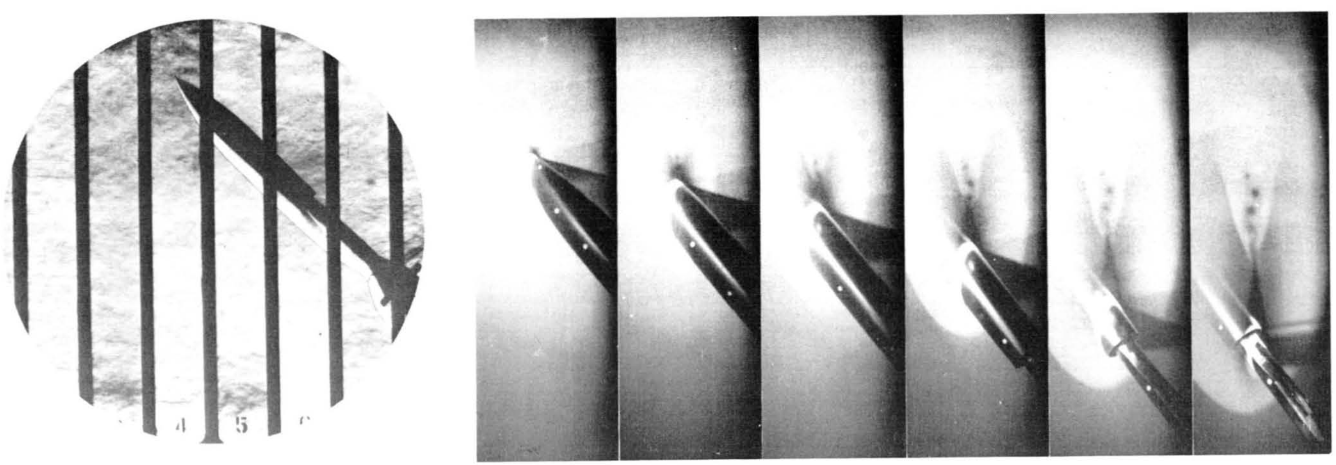
Figure 4.- Continued.

$x/l =$

0.125 0.325 0.475 0.675 0.925 1.000



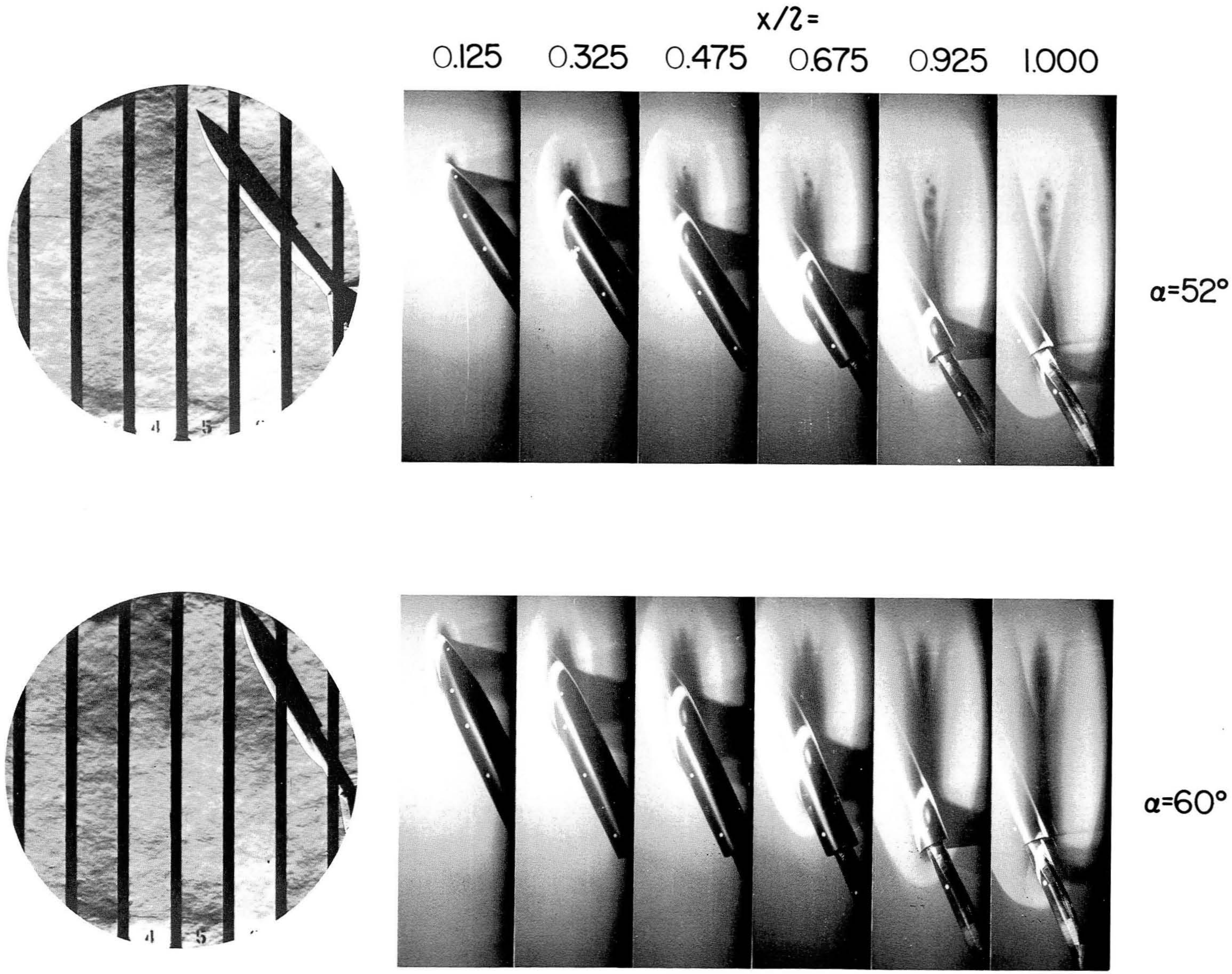
$\alpha = 36°$



$\alpha = 44°$

(c) Continued.

Figure 4.- Continued.



(c) Concluded.

Figure 4.- Continued.

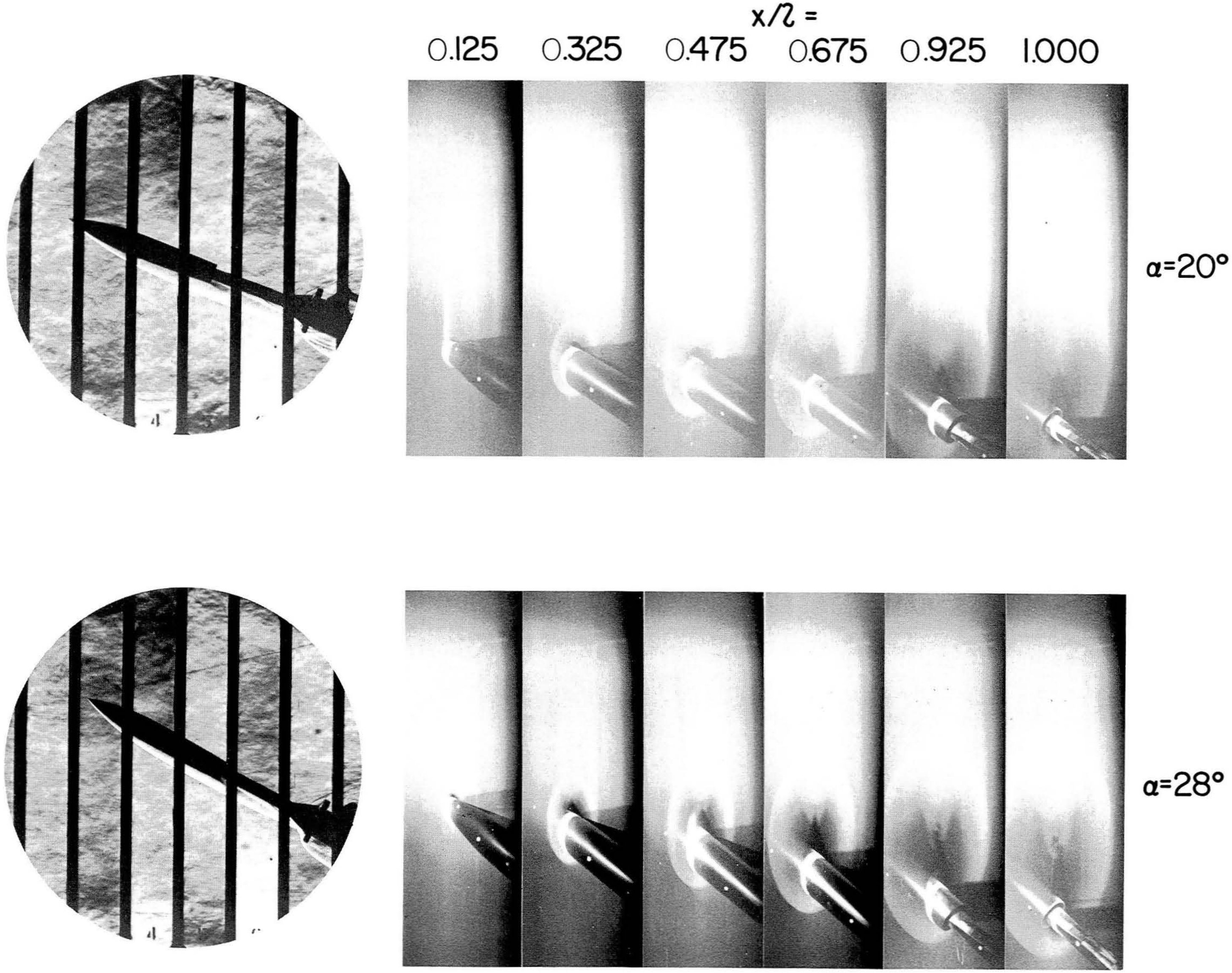
$\alpha = 0°$

$\alpha = 4°$

$\alpha = 12°$

(d) $M_\infty = 4.63$.

Figure 4.- Continued.

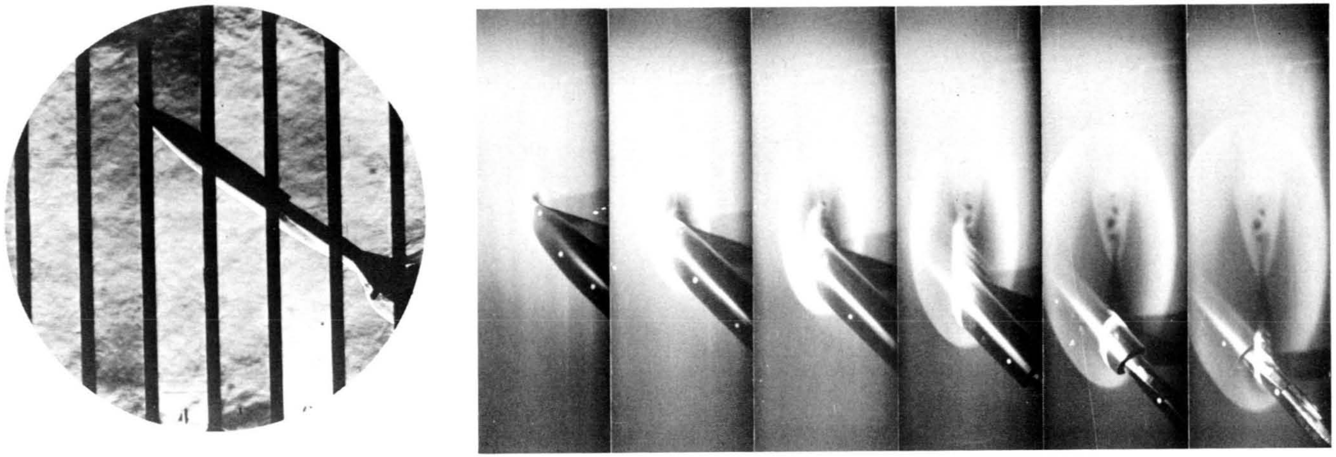


(d) Continued.

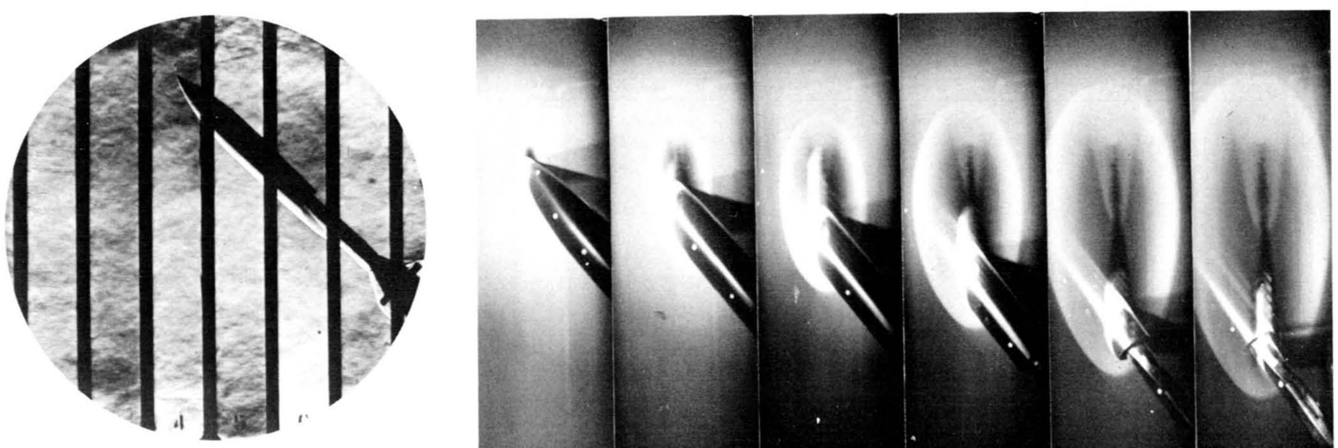
Figure 4.- Continued.

x/l=

0.125 0.325 0.475 0.675 0.925 1.000



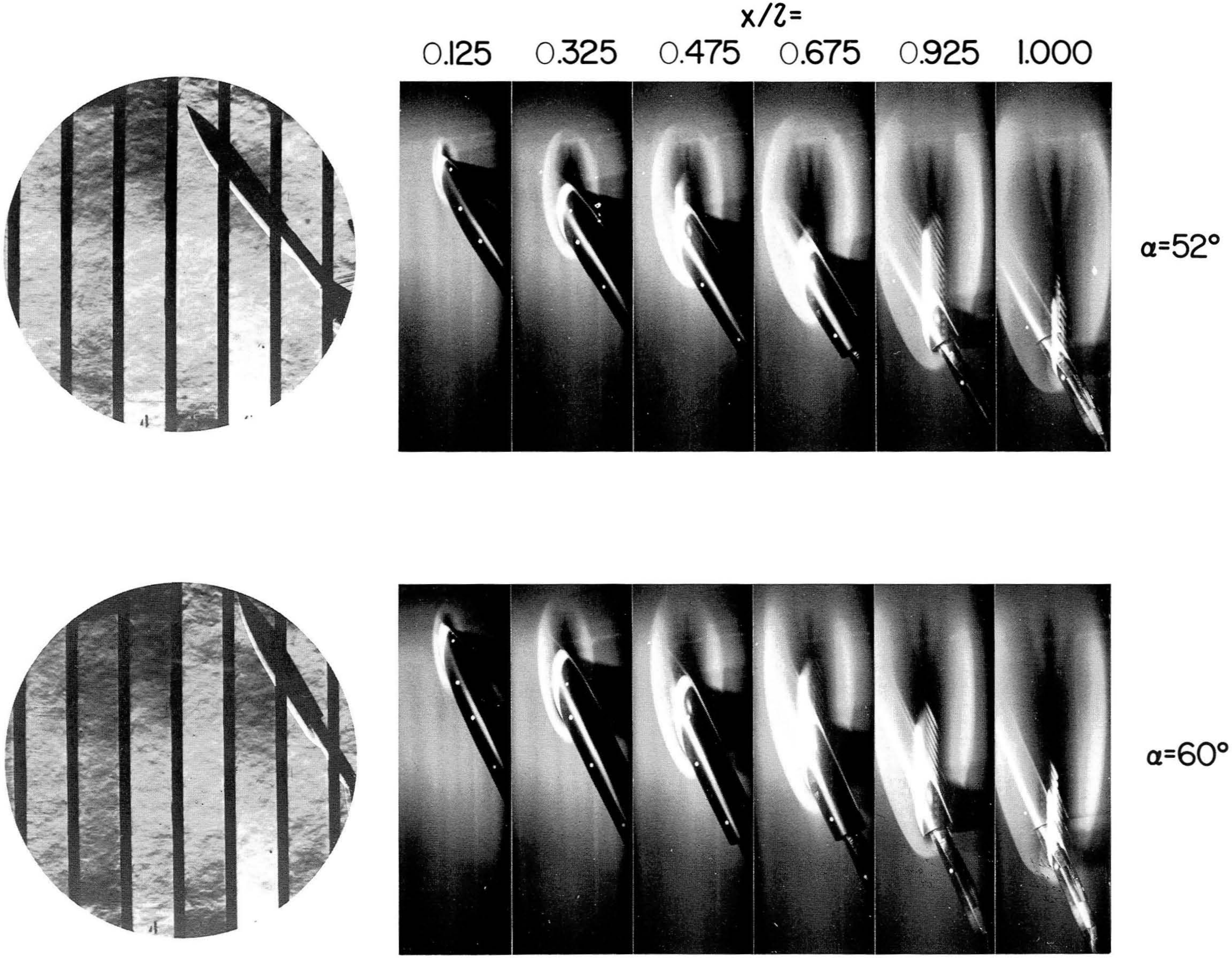
α=36°



α=44°

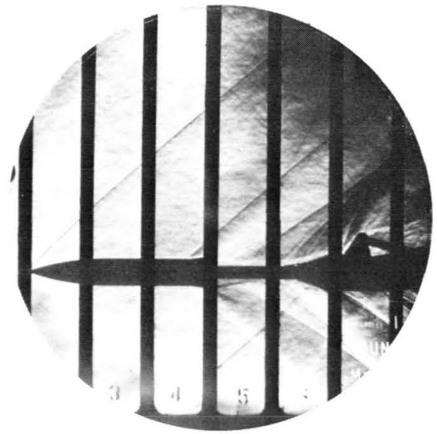
(d) Continued.

Figure 4.- Continued.



(d) Concluded.

Figure 4.- Concluded.



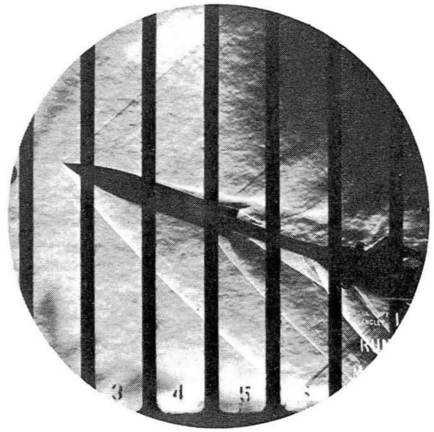
α=0°

α=4°

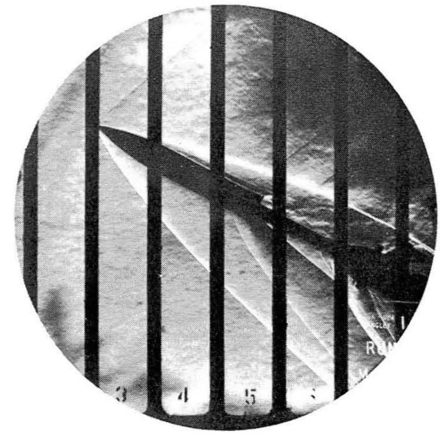
α =12°

(a) M_∞ = 1.6.

Figure 5.- Schlieren and vapor-screen photographs for circular-arc—cylinder—flare model.



$\alpha = 20°$



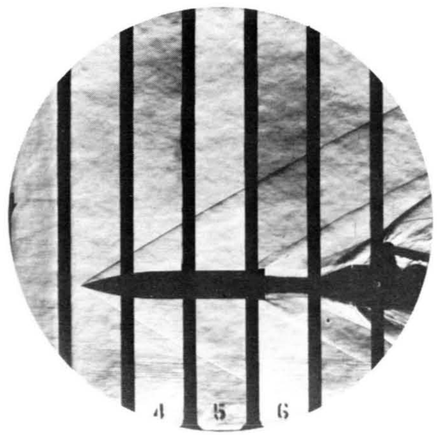
$\alpha = 28°$

$\alpha = 44°$

$\alpha = 36°$

(a) Concluded.

Figure 5.- Continued.



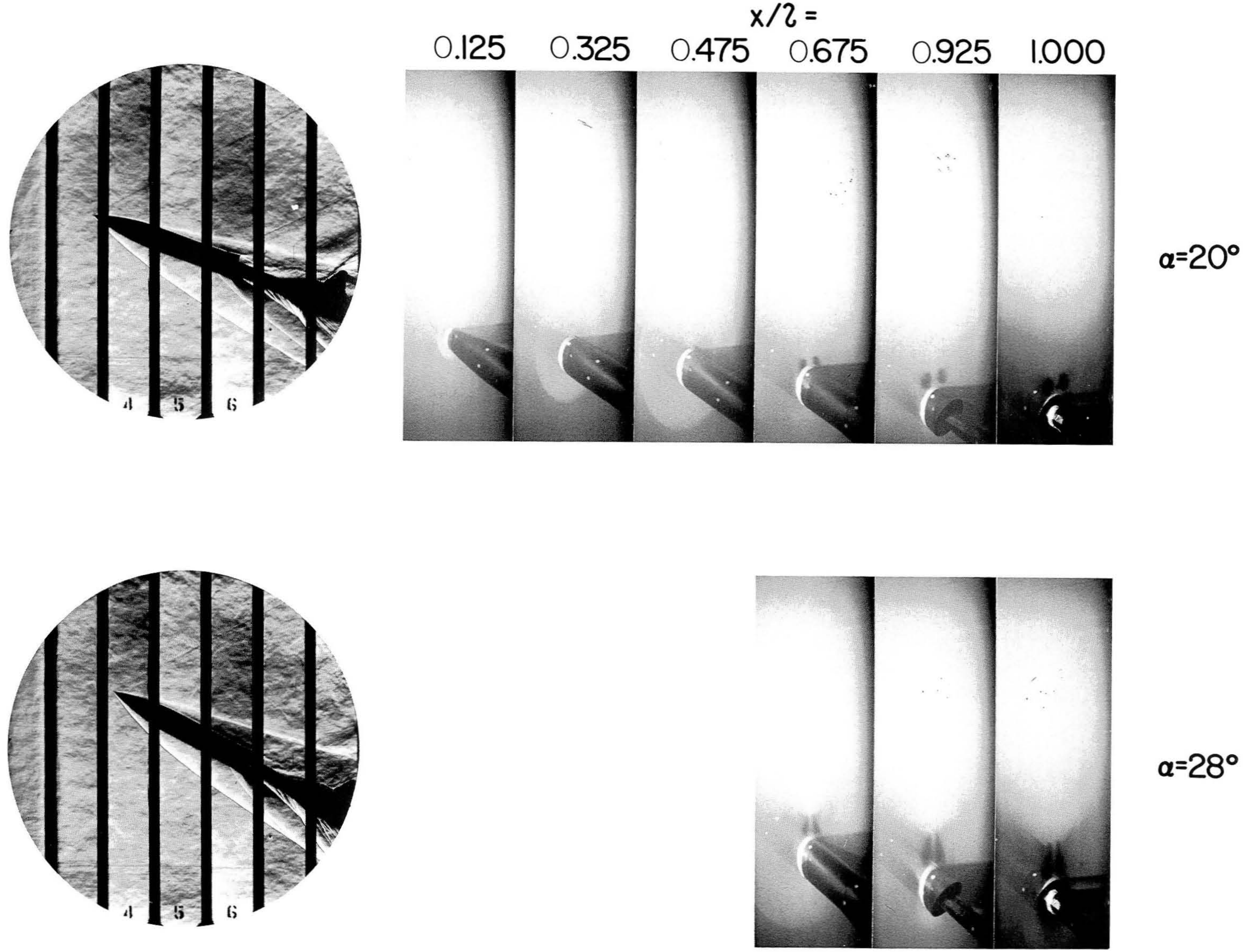
$\alpha = 0°$

$\alpha = 4°$

$\alpha = 12°$

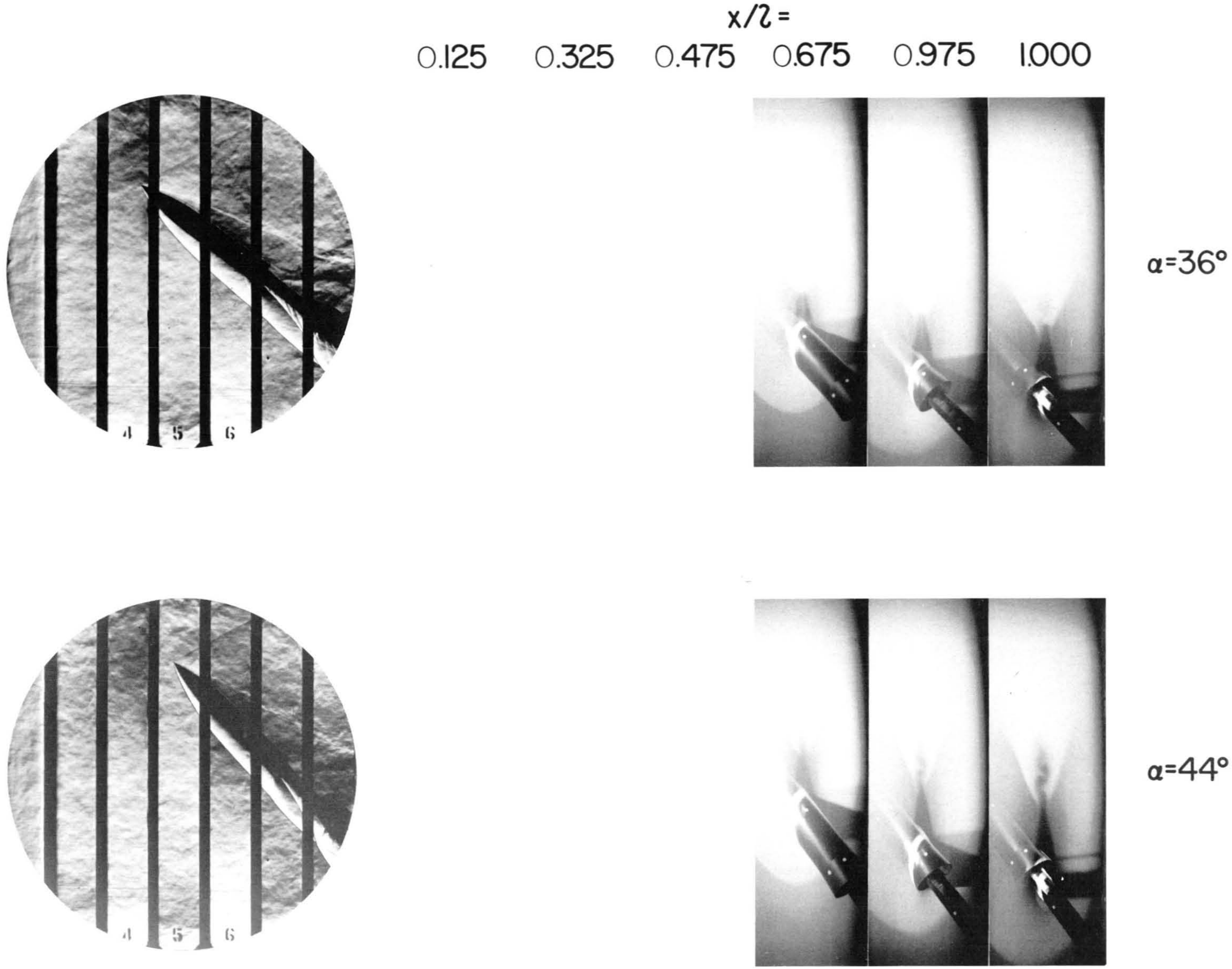
(b) $M_\infty = 2.3$.

Figure 5.- Continued.



(b) Continued.

Figure 5.- Continued.

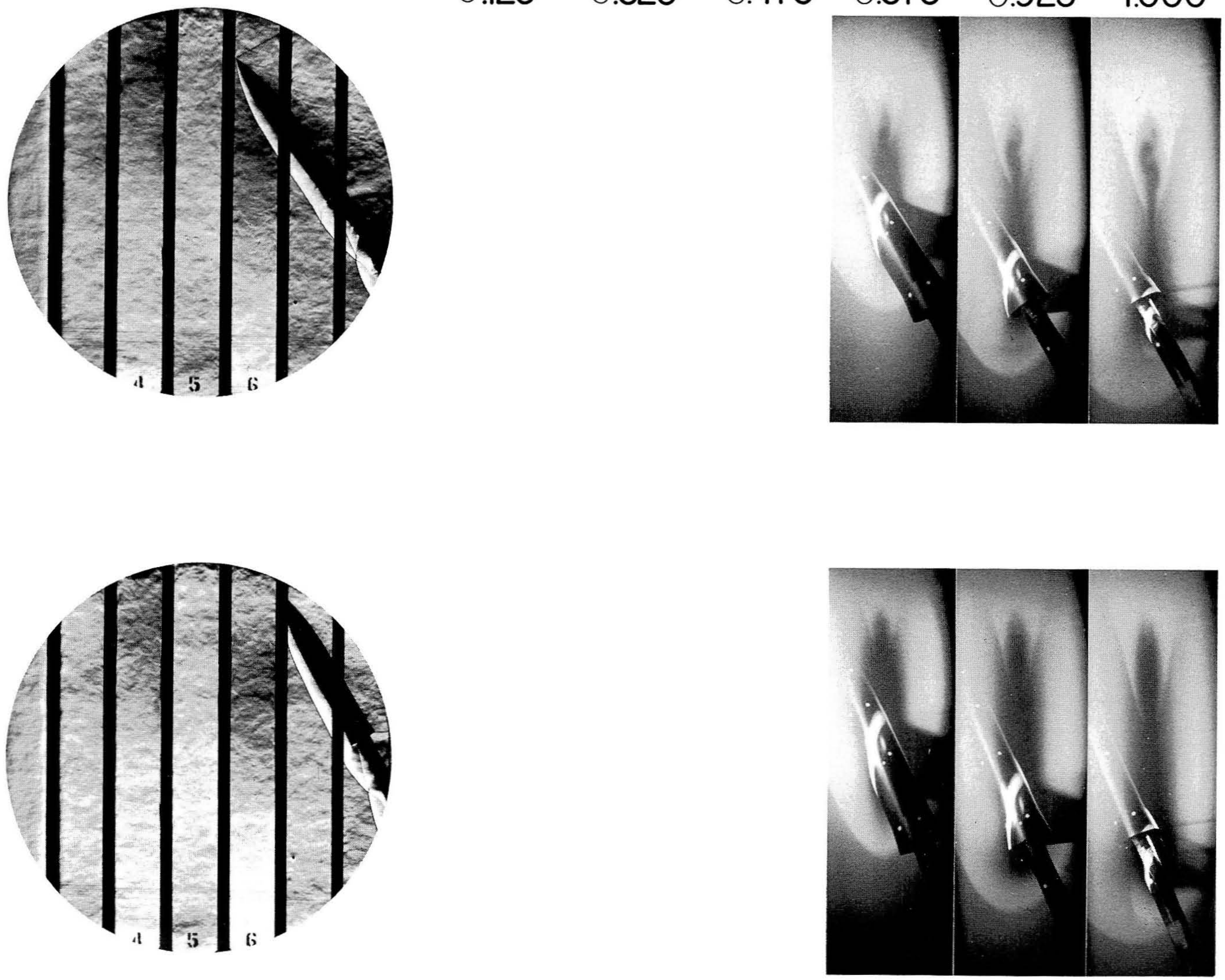


(b) Continued.

Figure 5.- Continued.

$x/l =$

0.125 0.325 0.475 0.675 0.925 1.000



$\alpha = 52°$

$\alpha = 60°$

(b) Concluded.

Figure 5.- Continued.

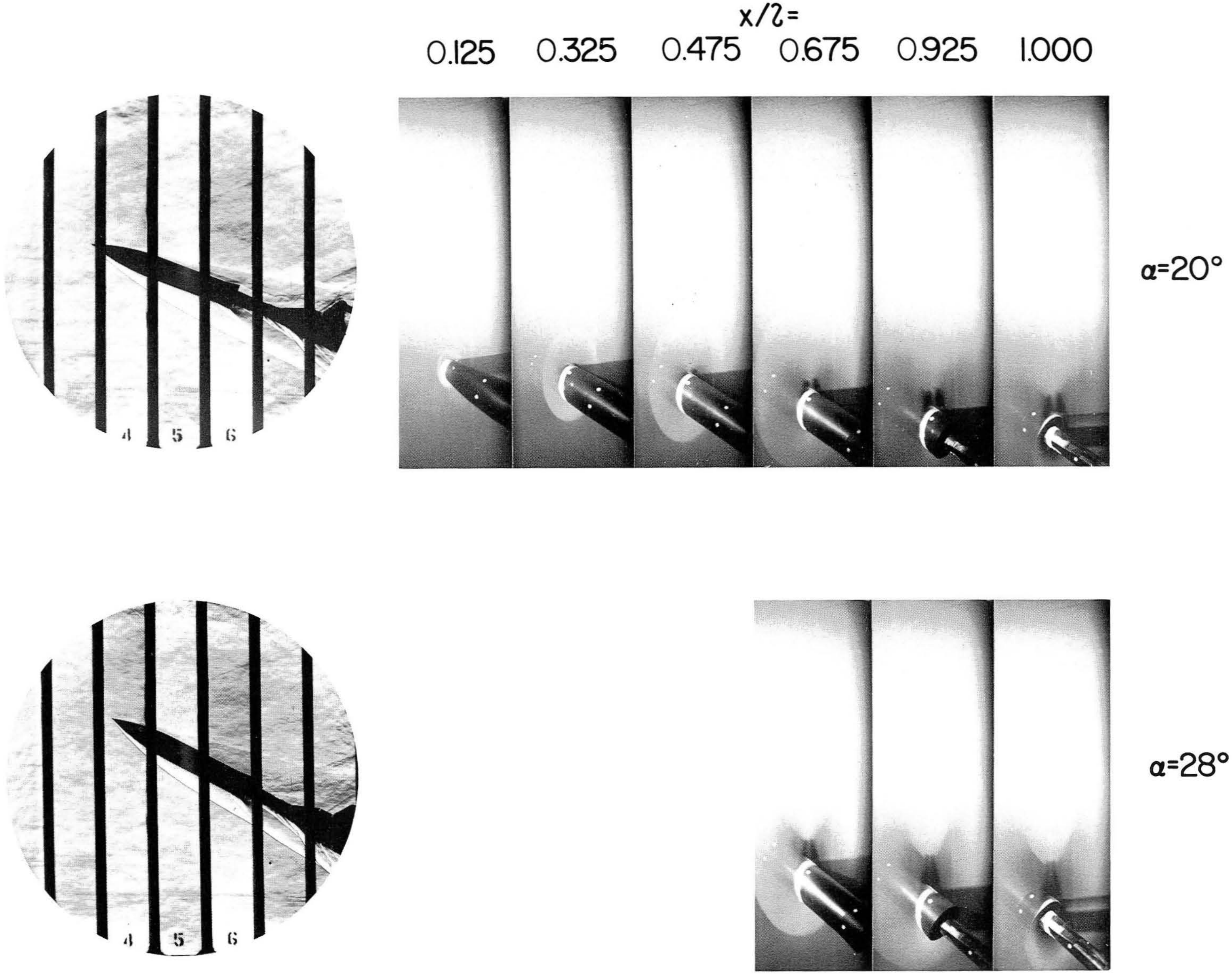
$\alpha = 0°$

$\alpha = 4°$

$\alpha = 12°$

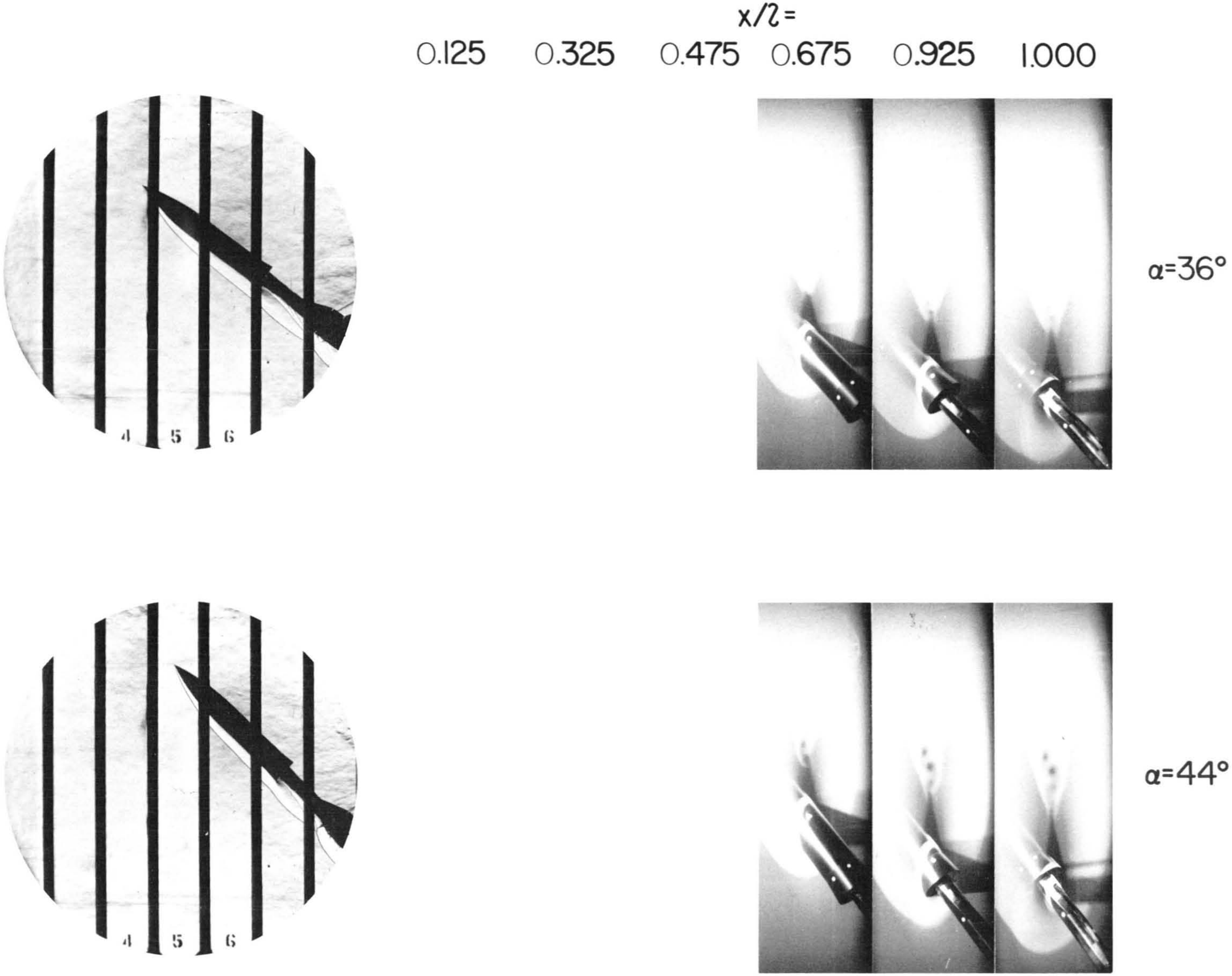
$M_{\infty} = 2.96.$

Figure 5.- Continued.



(c) Continued.

Figure 5.- Continued.

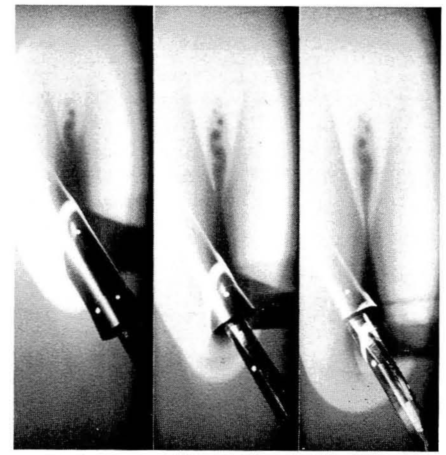


(c) Continued.

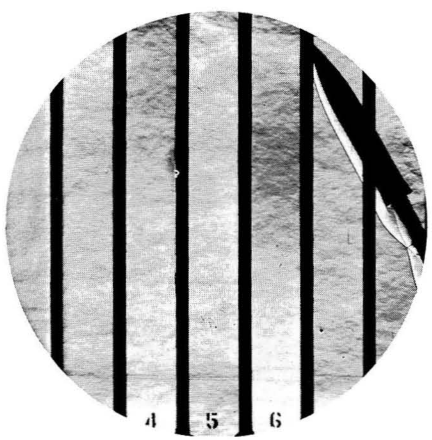
Figure 5.- Continued.

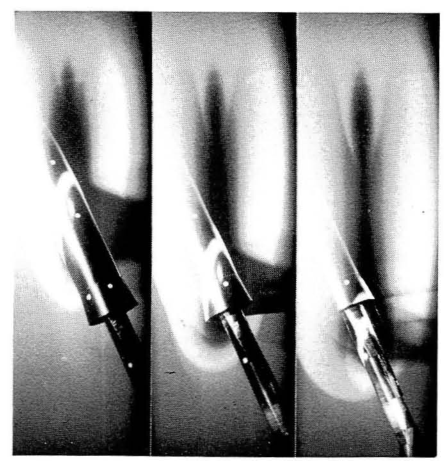
$x/l =$

0.125 0.325 0.475 0.675 0.925 1.000



$\alpha = 52^\circ$





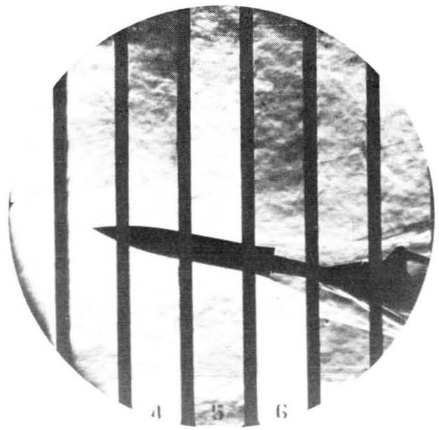
$\alpha = 60^\circ$

(c) Concluded.

Figure 5.- Continued.

α=0°

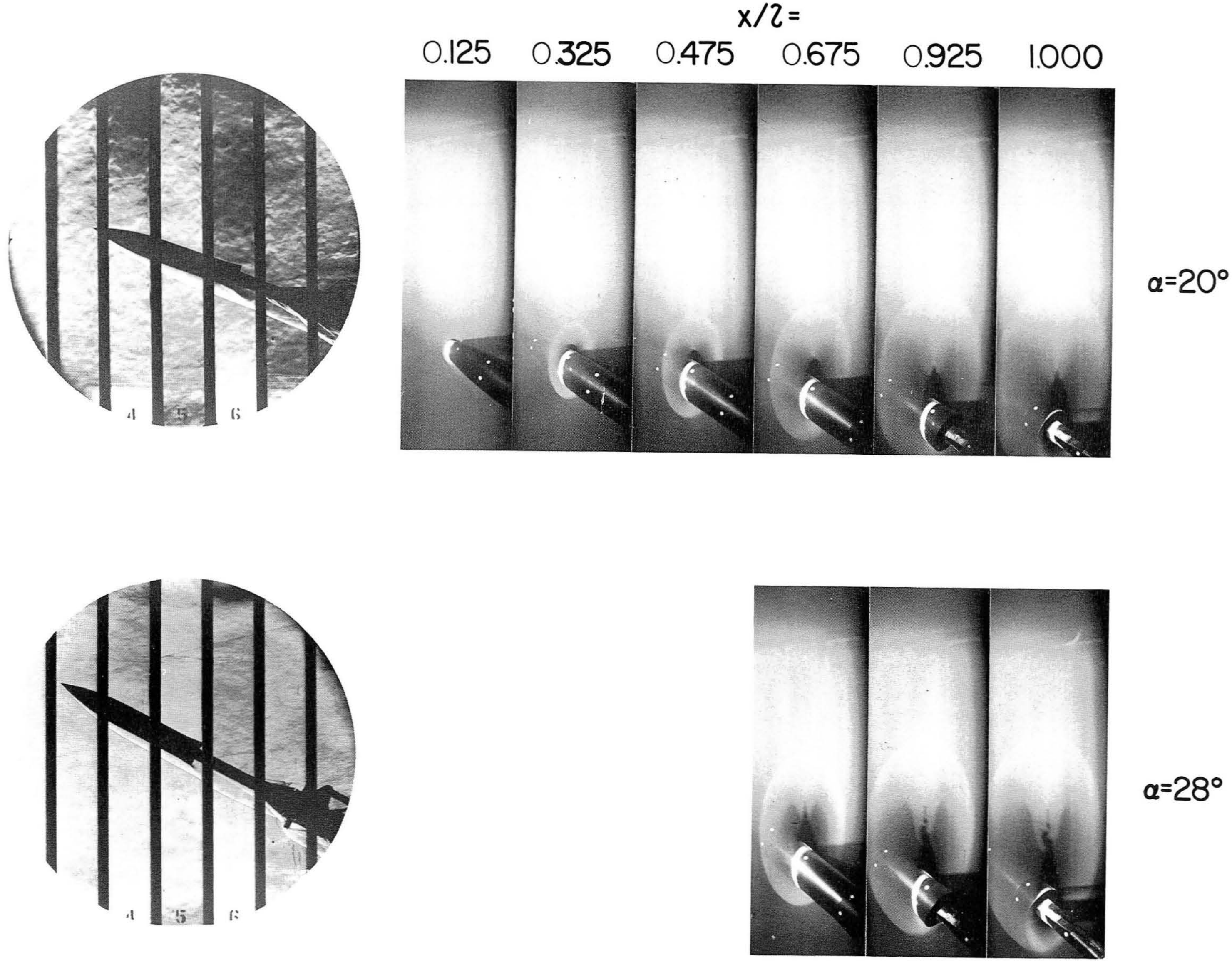
α=4°



α=12°

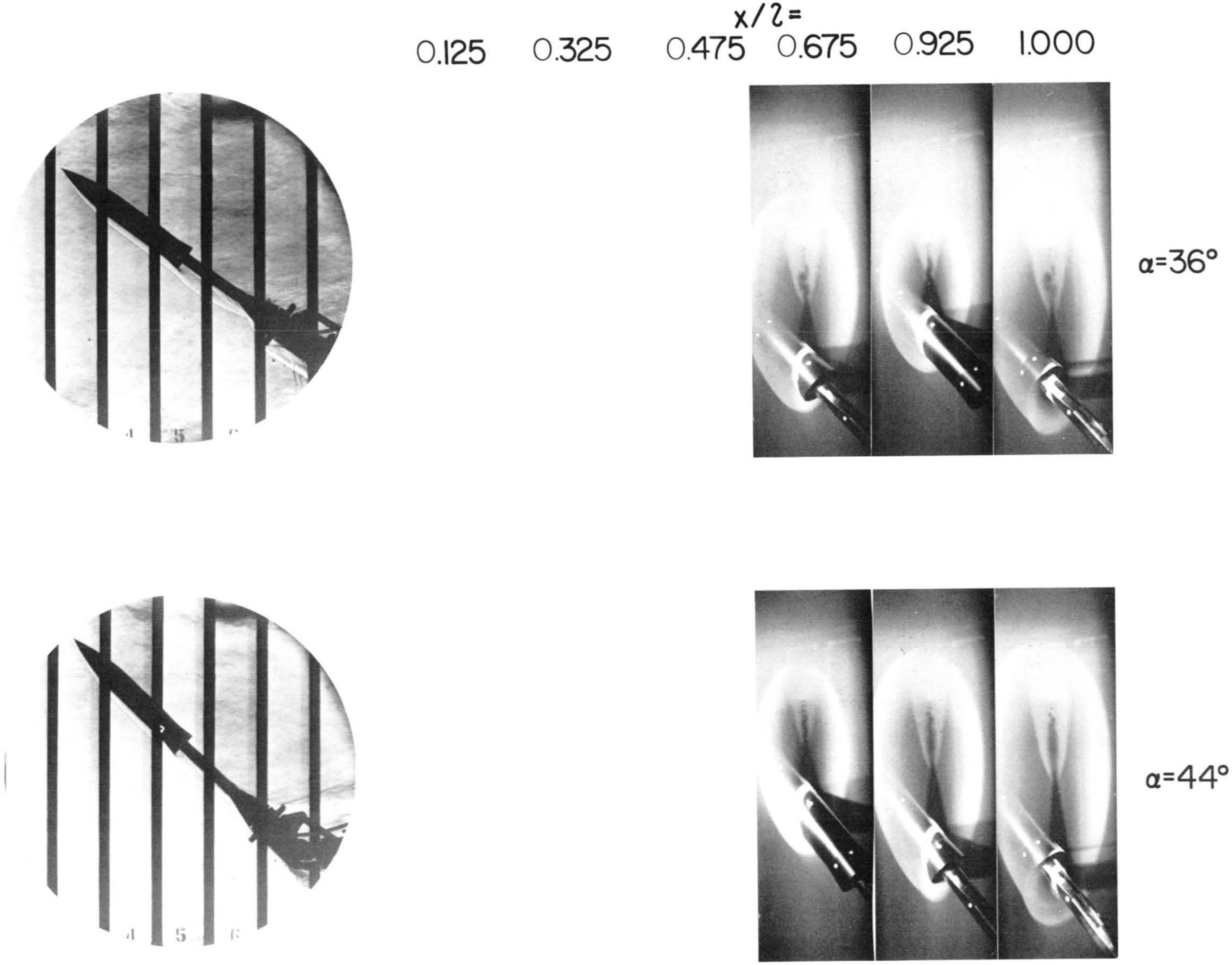
(d) $M_\infty = 4.63$.

Figure 5.- Continued.



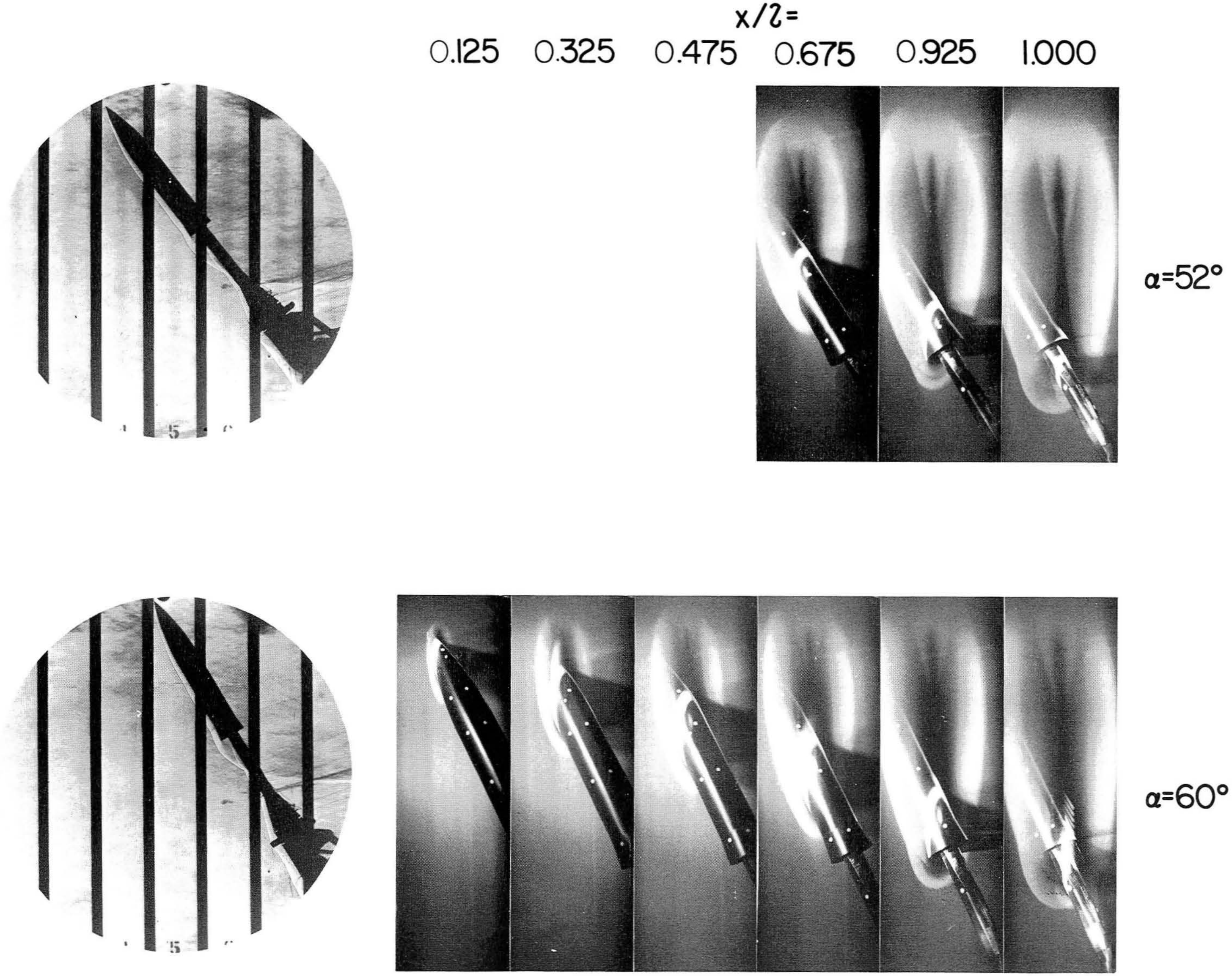
(d) Continued.

Figure 5.- Continued.



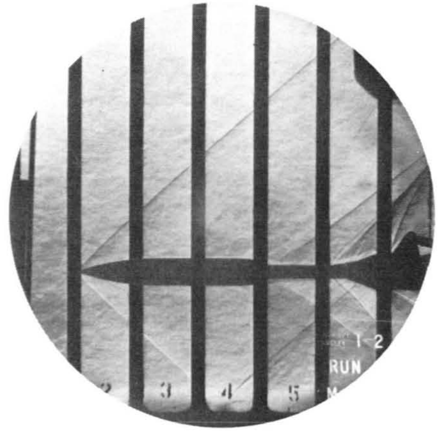
(d) Continued.

Figure 5.- Continued.

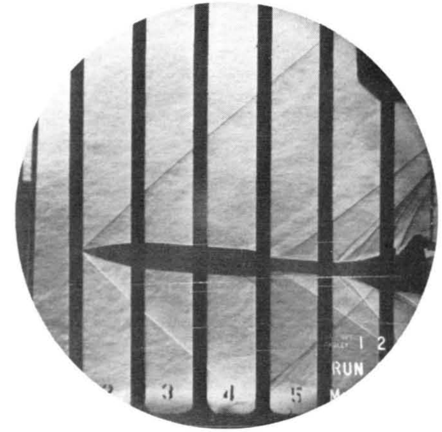


(d) Concluded.

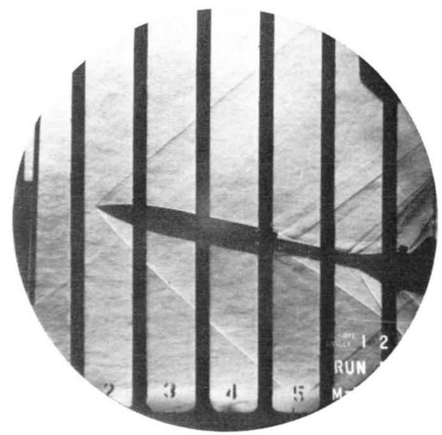
Figure 5.- Concluded.



α=0°



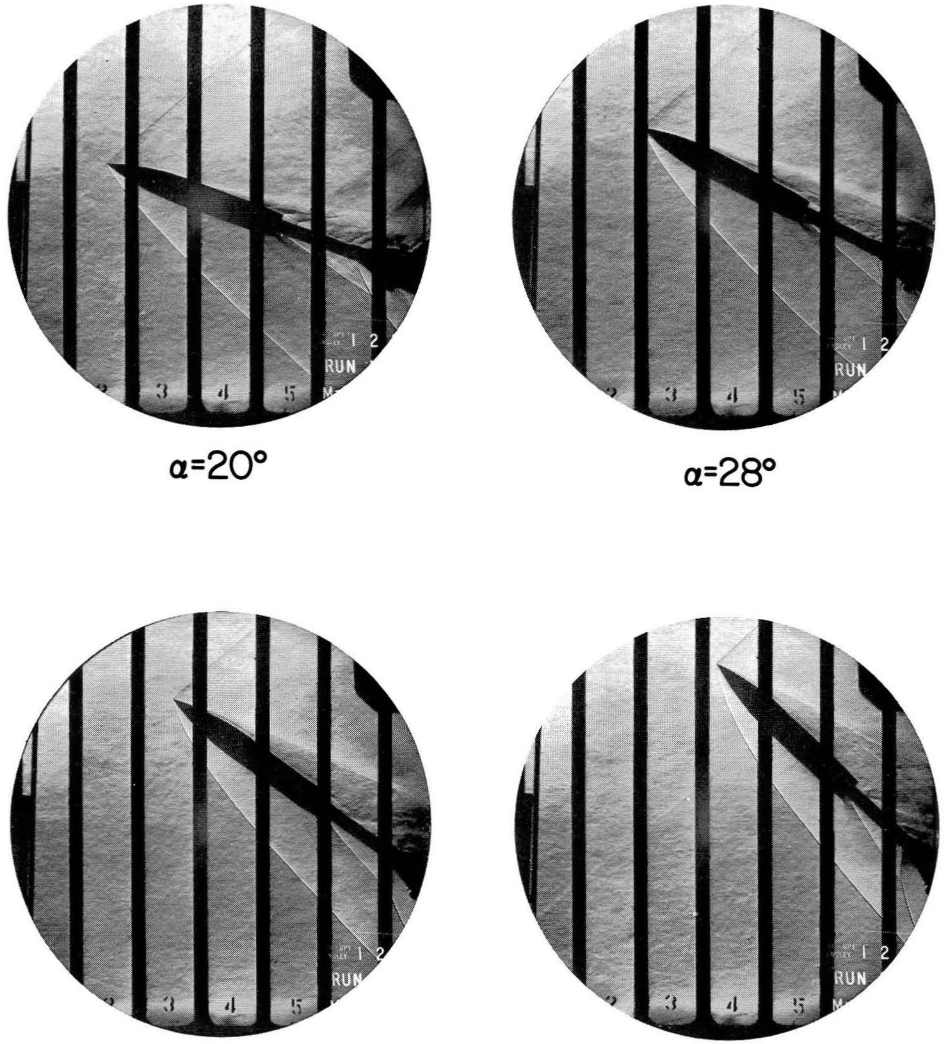
α=4°



α=12°

(a) $M_\infty = 1.6$.

Figure 6.- Schlieren and vapor-screen photographs for circular-arc-boattail model.



α=20°　α=28°

α=36°　α=44°

(a) Concluded.

Figure 6.- Continued.

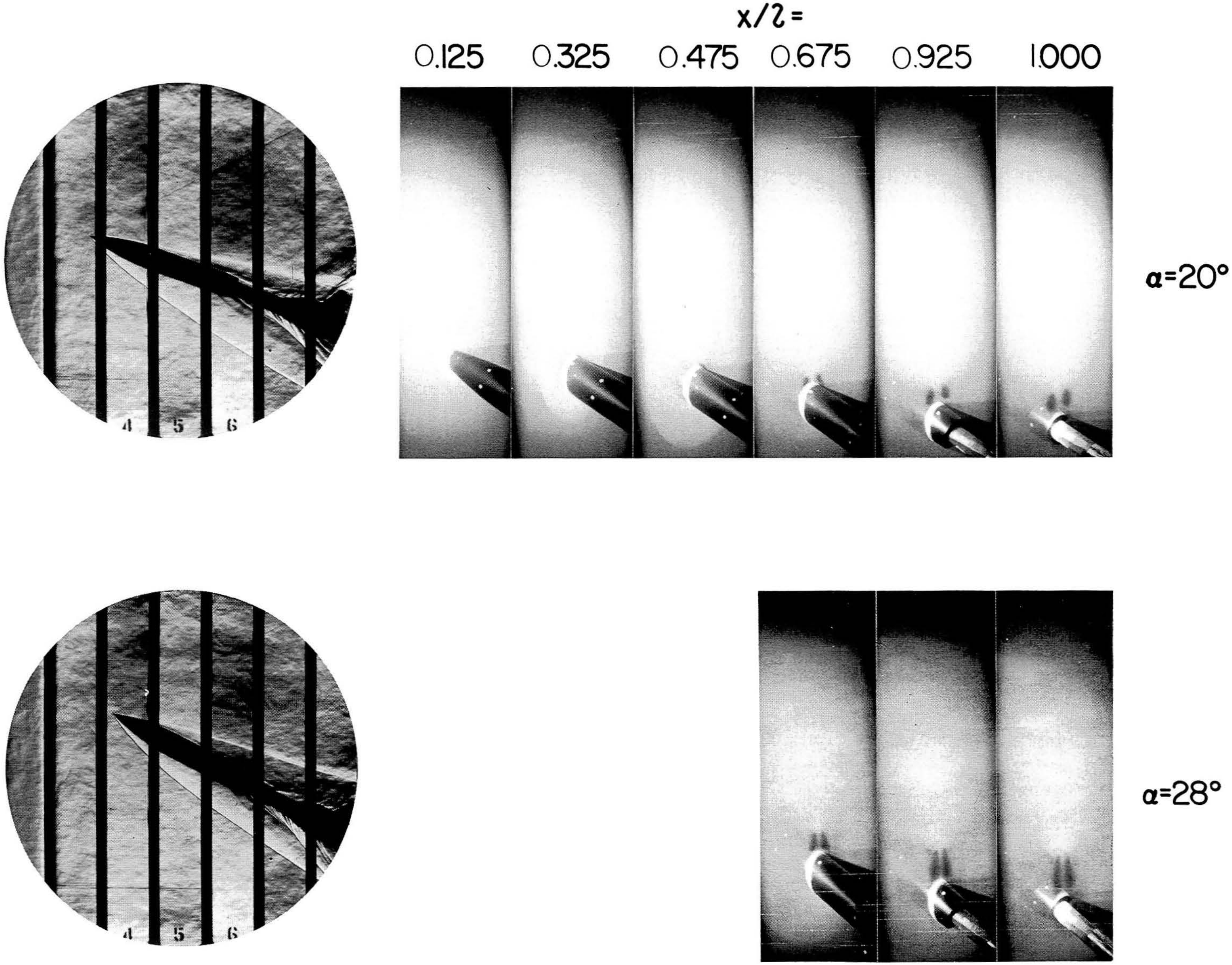
$\alpha=0°$

$\alpha=4°$

$\alpha=12°$

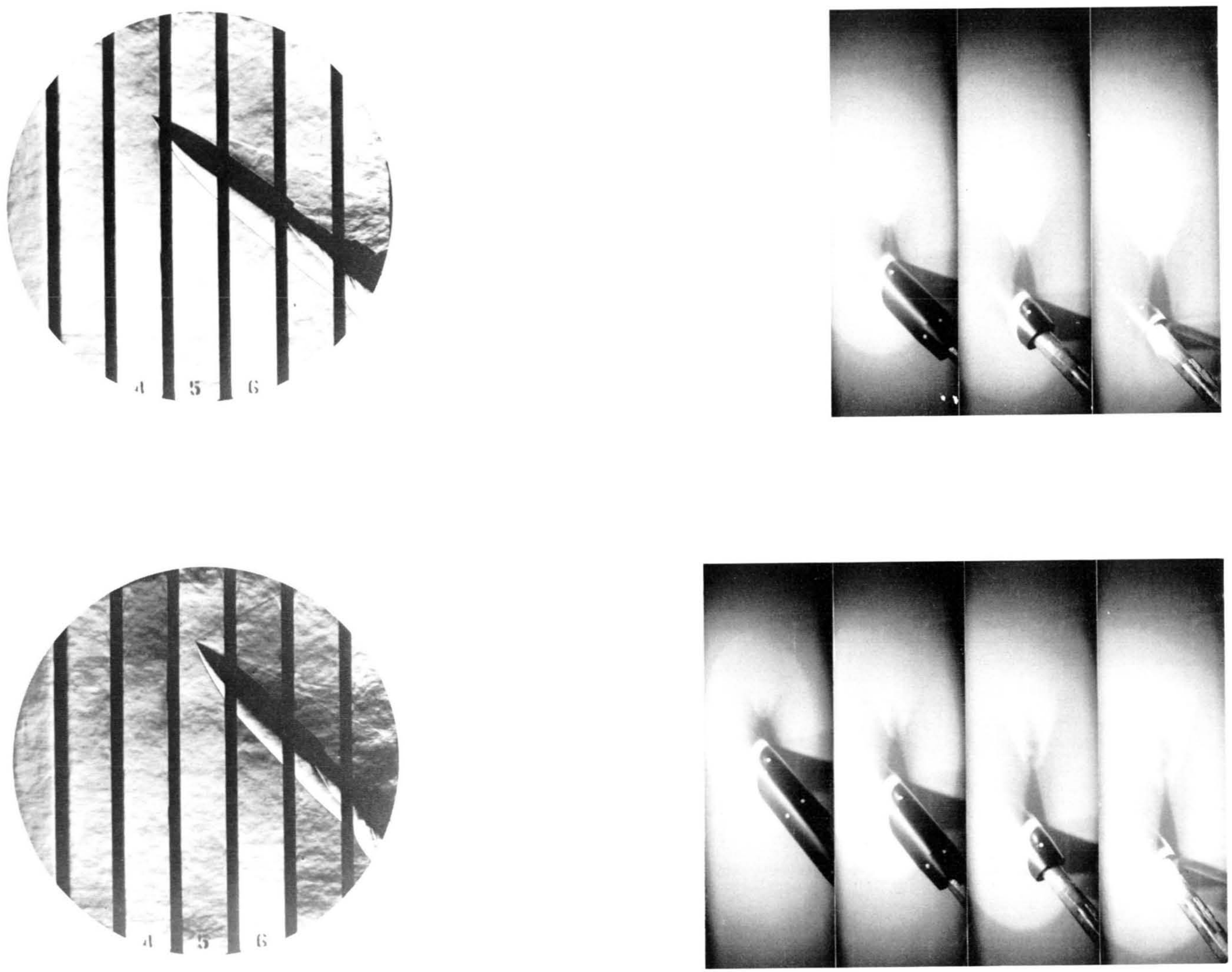
(b) $M_{\infty} = 2.3$.

Figure 6.- Continued.



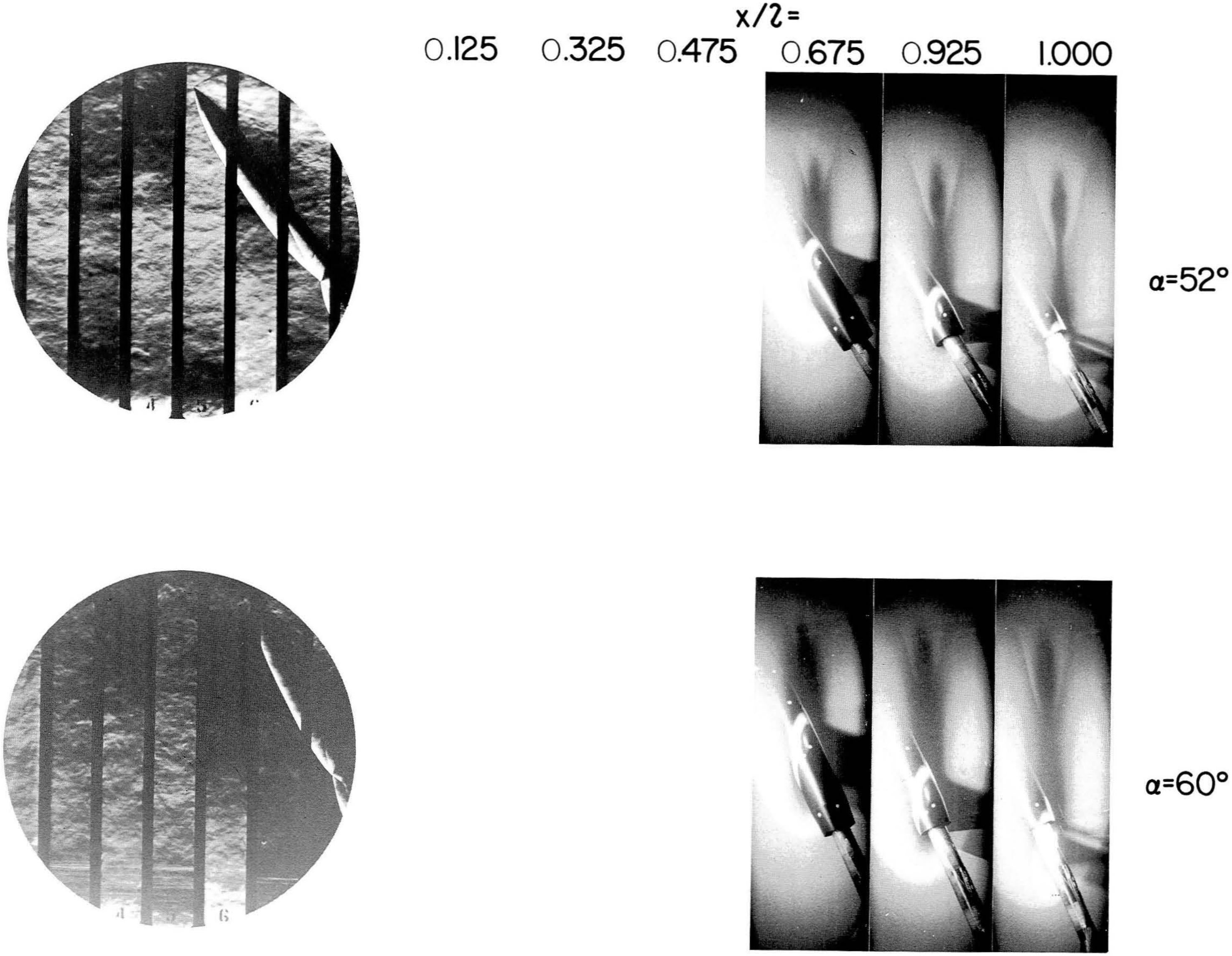
(b) Continued.

Figure 6.- Continued.



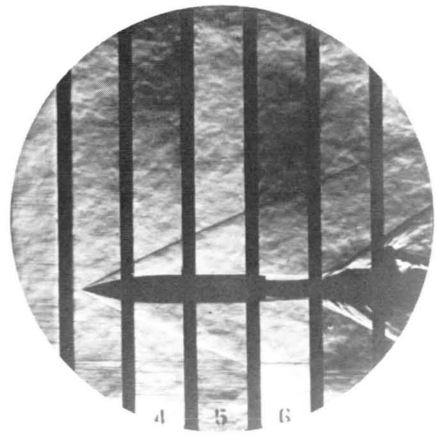
(b) Continued.

Figure 6.- Continued.

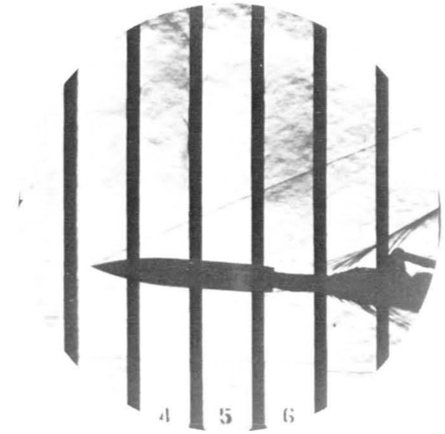


(b) Concluded.

Figure 6.- Continued.



$\alpha = 0°$

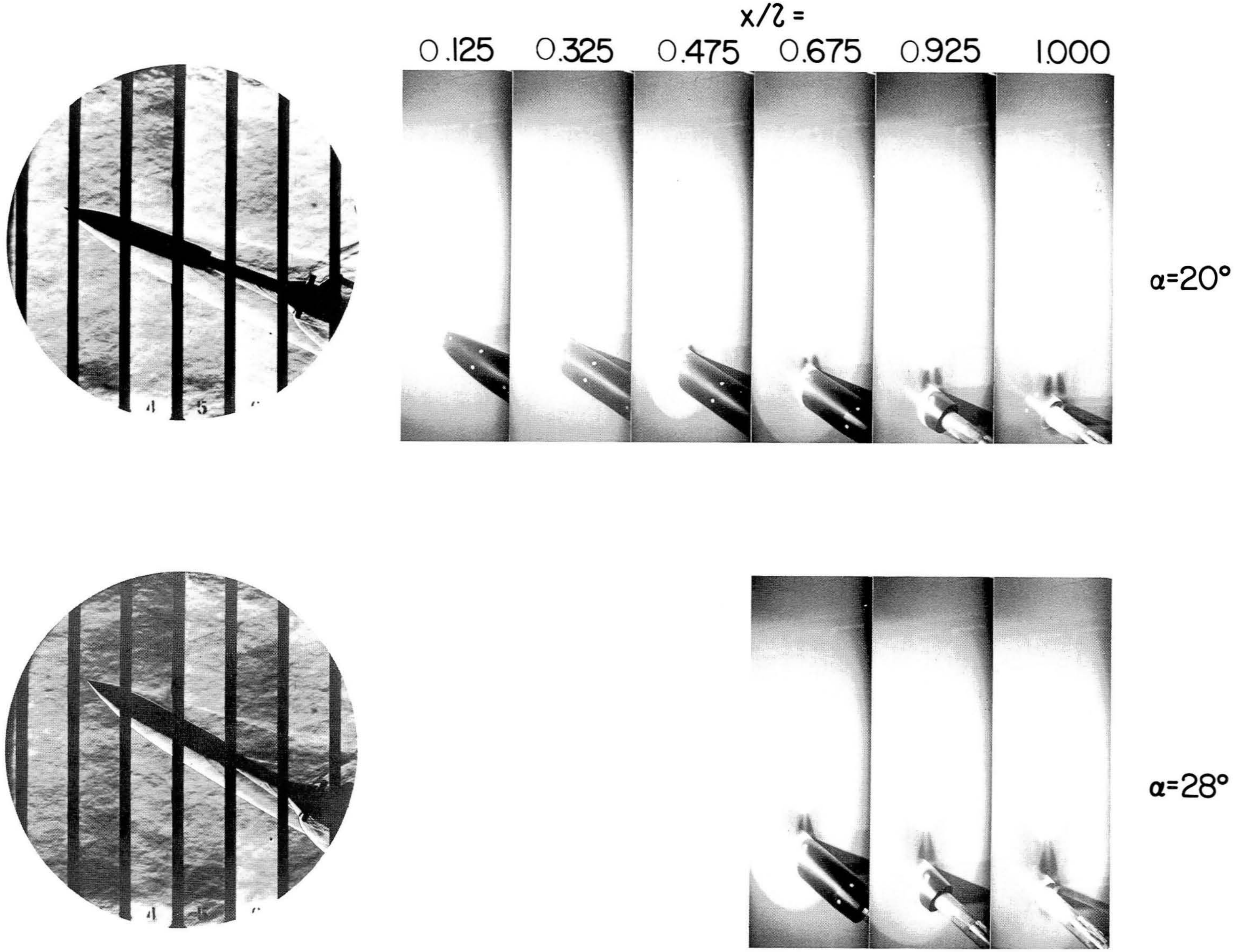


$\alpha = 4°$

$\alpha = 12°$

(c) $M_\infty = 2.96$.

Figure 6.- Continued.



(c) Continued.

Figure 6.- Continued.

$x/l =$

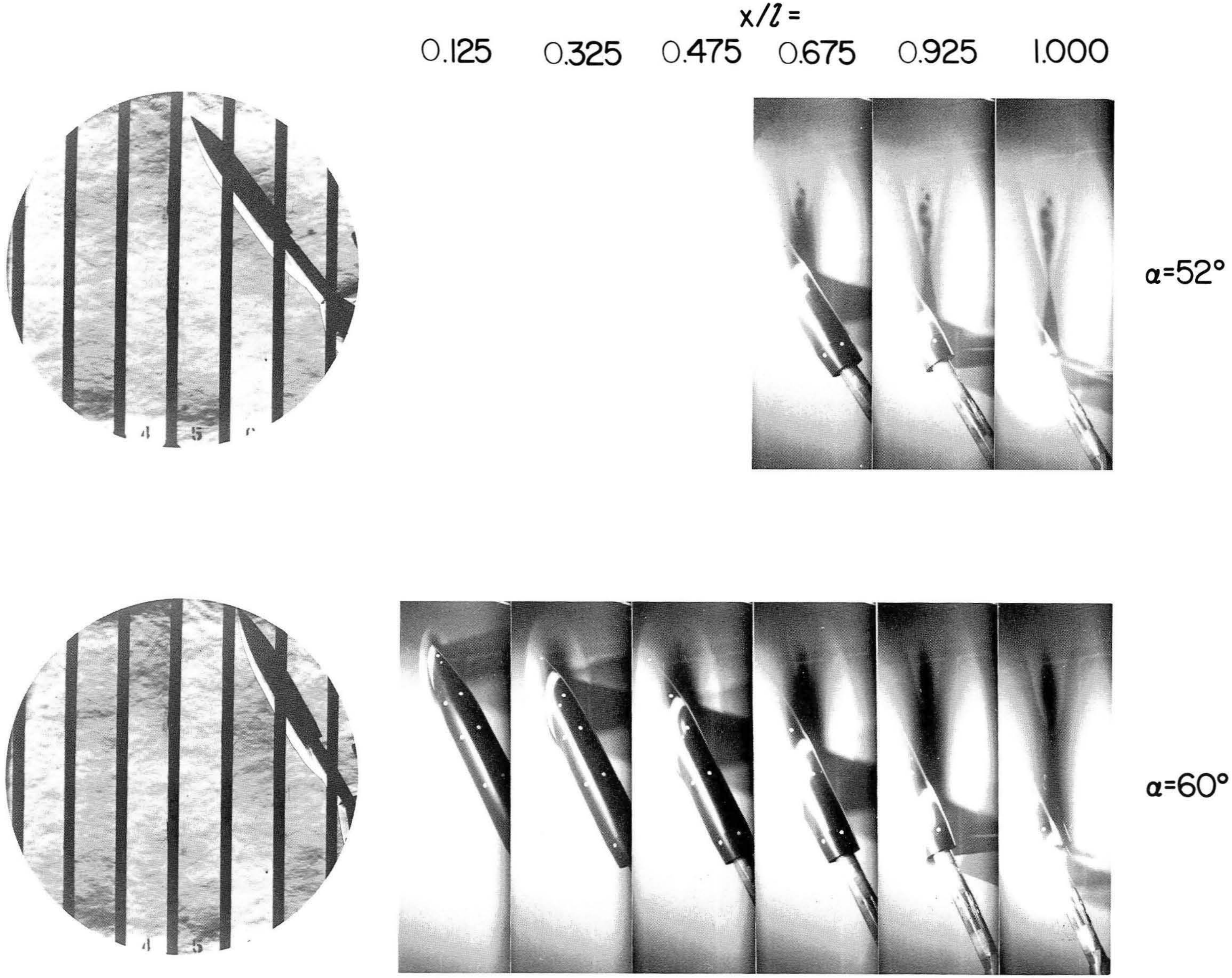
0.125 0.325 0.475 0.675 0.925 1.000

$\alpha = 36°$

$\alpha = 44°$

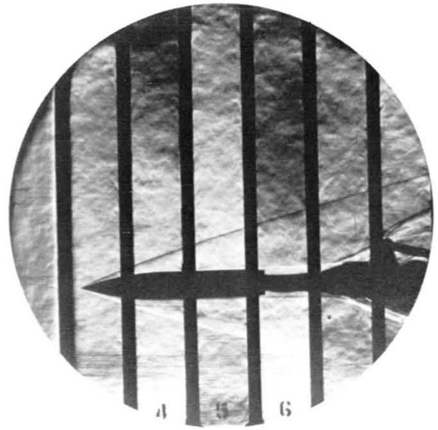
(c) Continued.

Figure 6.- Continued.



(c) Concluded.

Figure 6.- Continued.



$\alpha = 0°$

$\alpha = 4°$

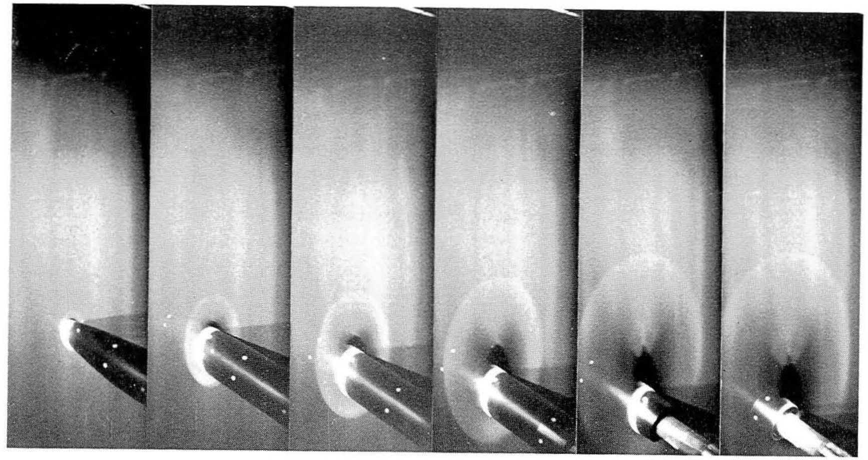
$\alpha = 12°$

(d) $M_\infty = 4.63$.

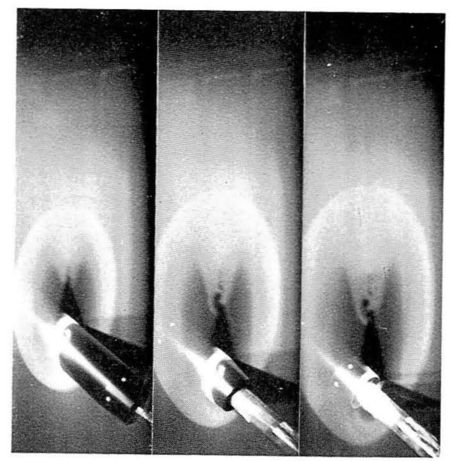
Figure 6.- Continued.

$x/l =$

0.125 0.325 0.475 0.675 0.925 1.000



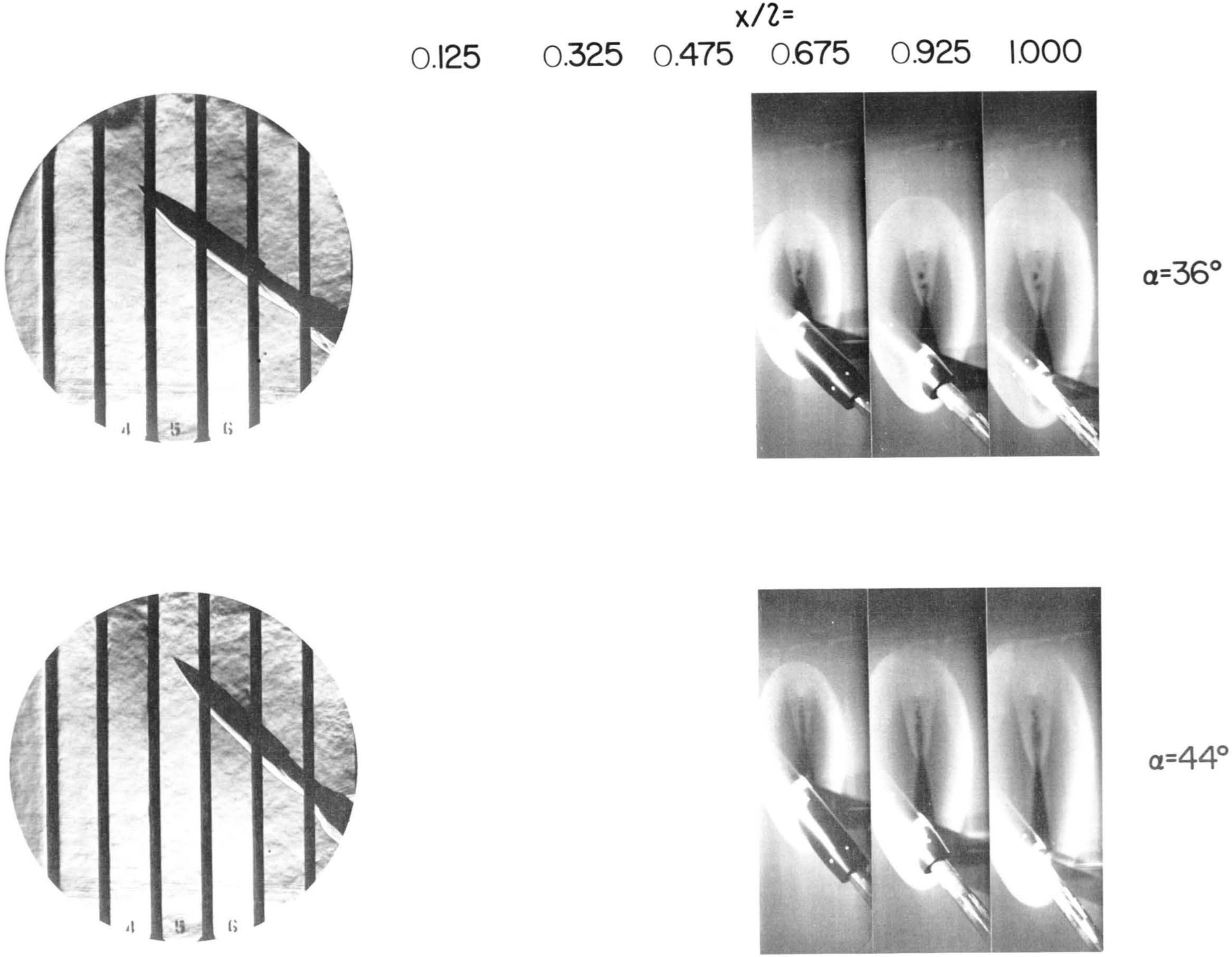
$\alpha = 20°$



$\alpha = 28°$

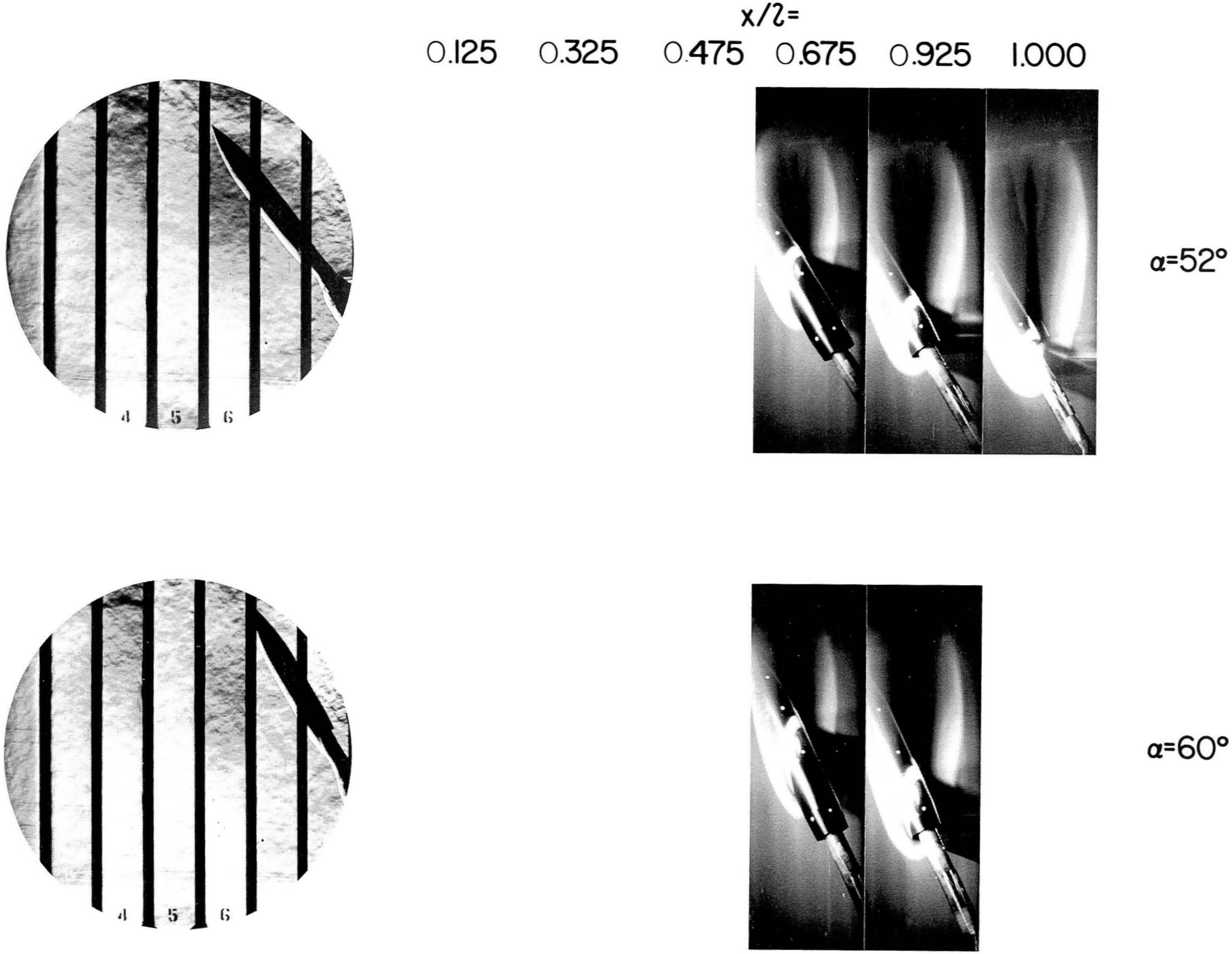
(d) Continued.

Figure 6.- Continued.



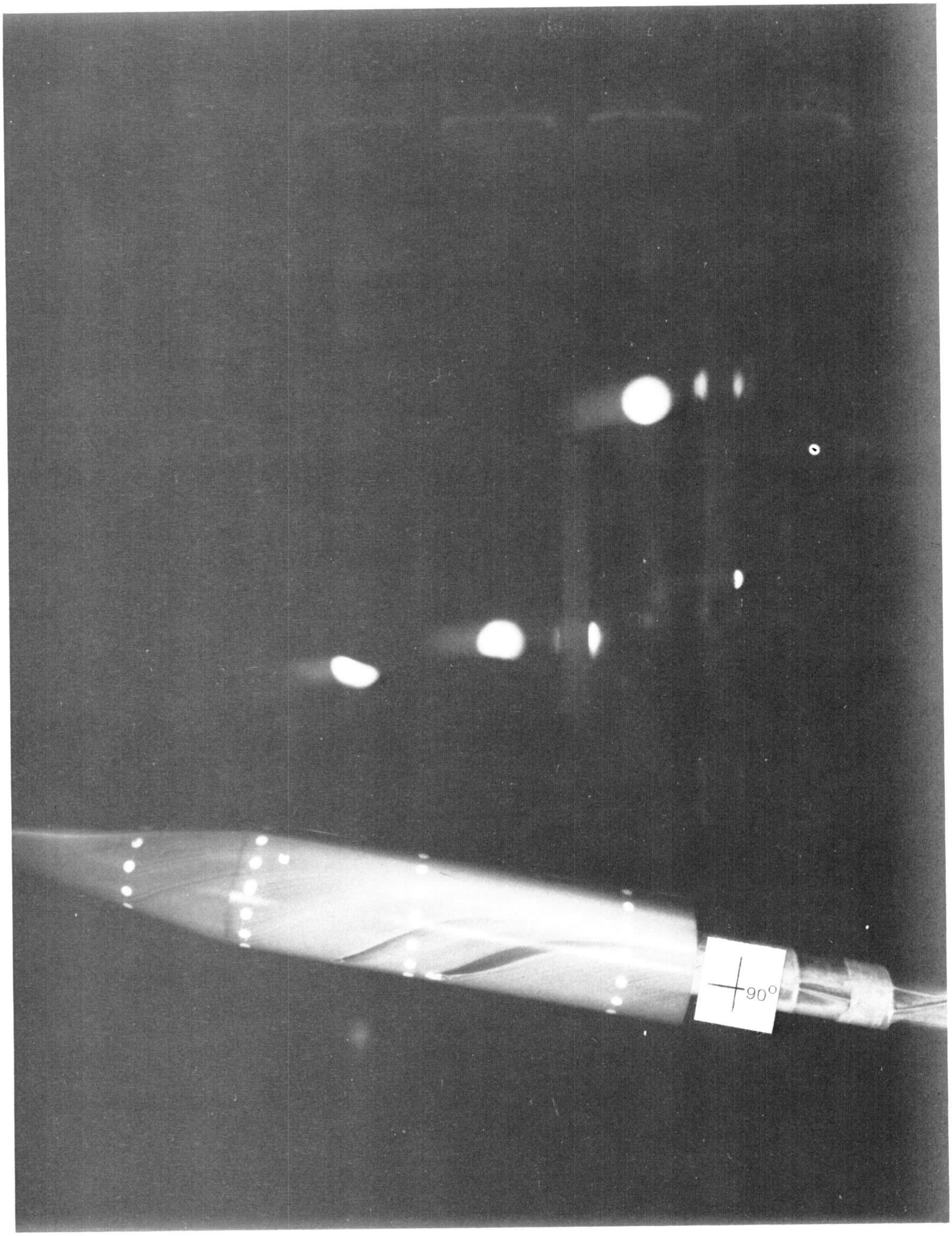
(d) Continued.

Figure 6.- Continued.



(d) Concluded.

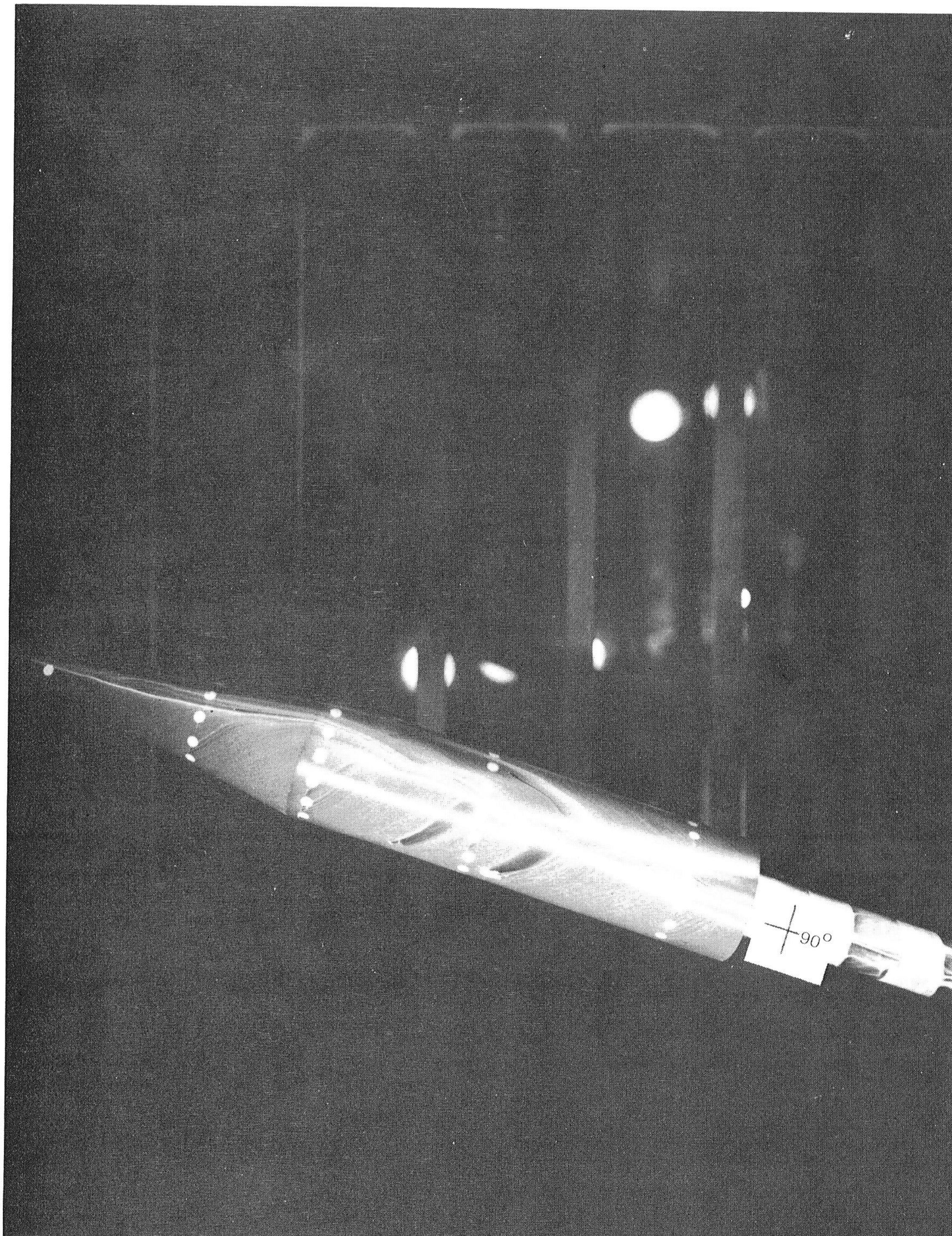
Figure 6.- Concluded.



$\alpha = 12^{\circ}$

(a) $M_{\infty} = 1.6$.

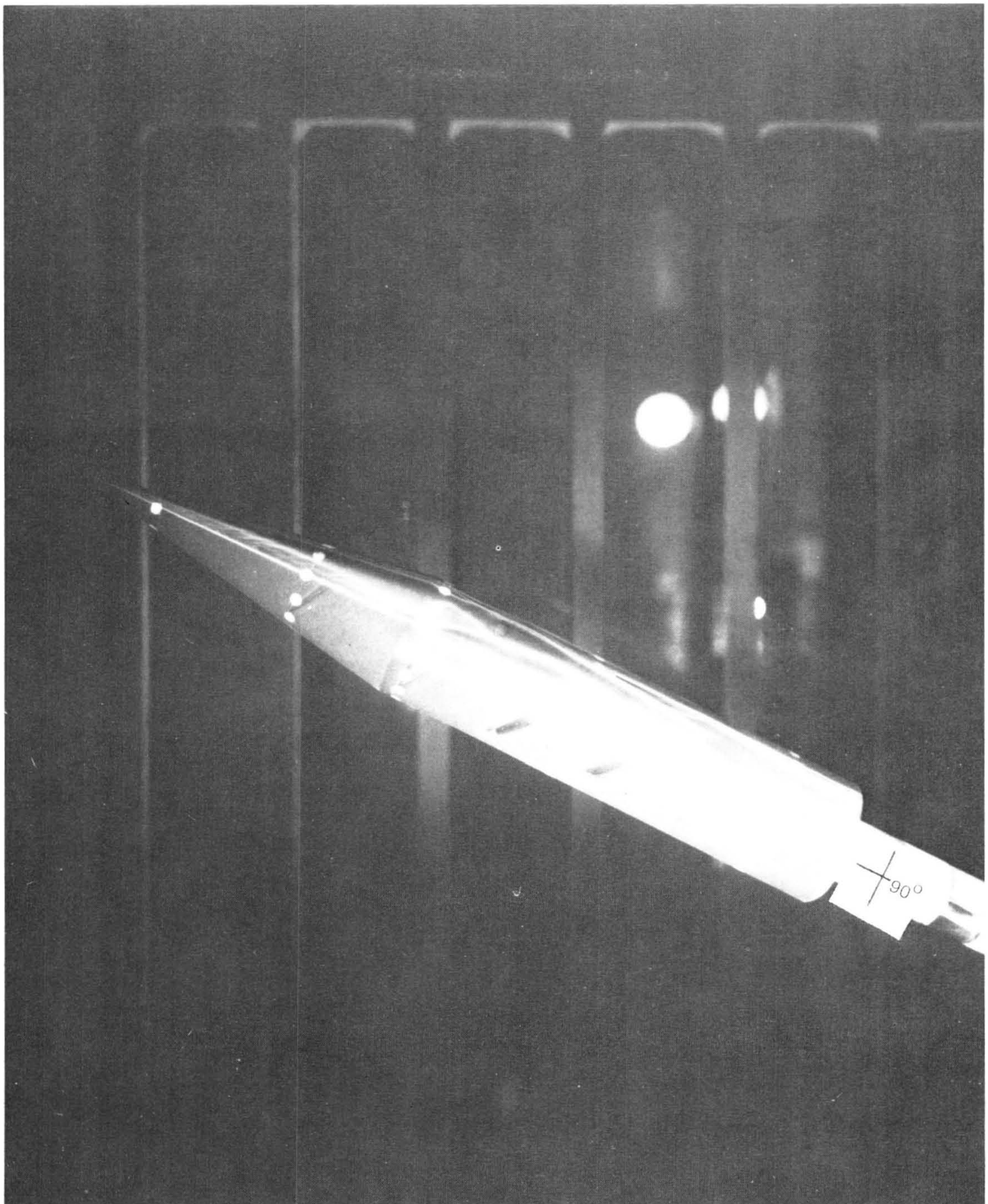
Figure 7.- Oil-flow photographs for cone-cylinder model.



$\alpha = 20^{\circ}$

(a) Continued.

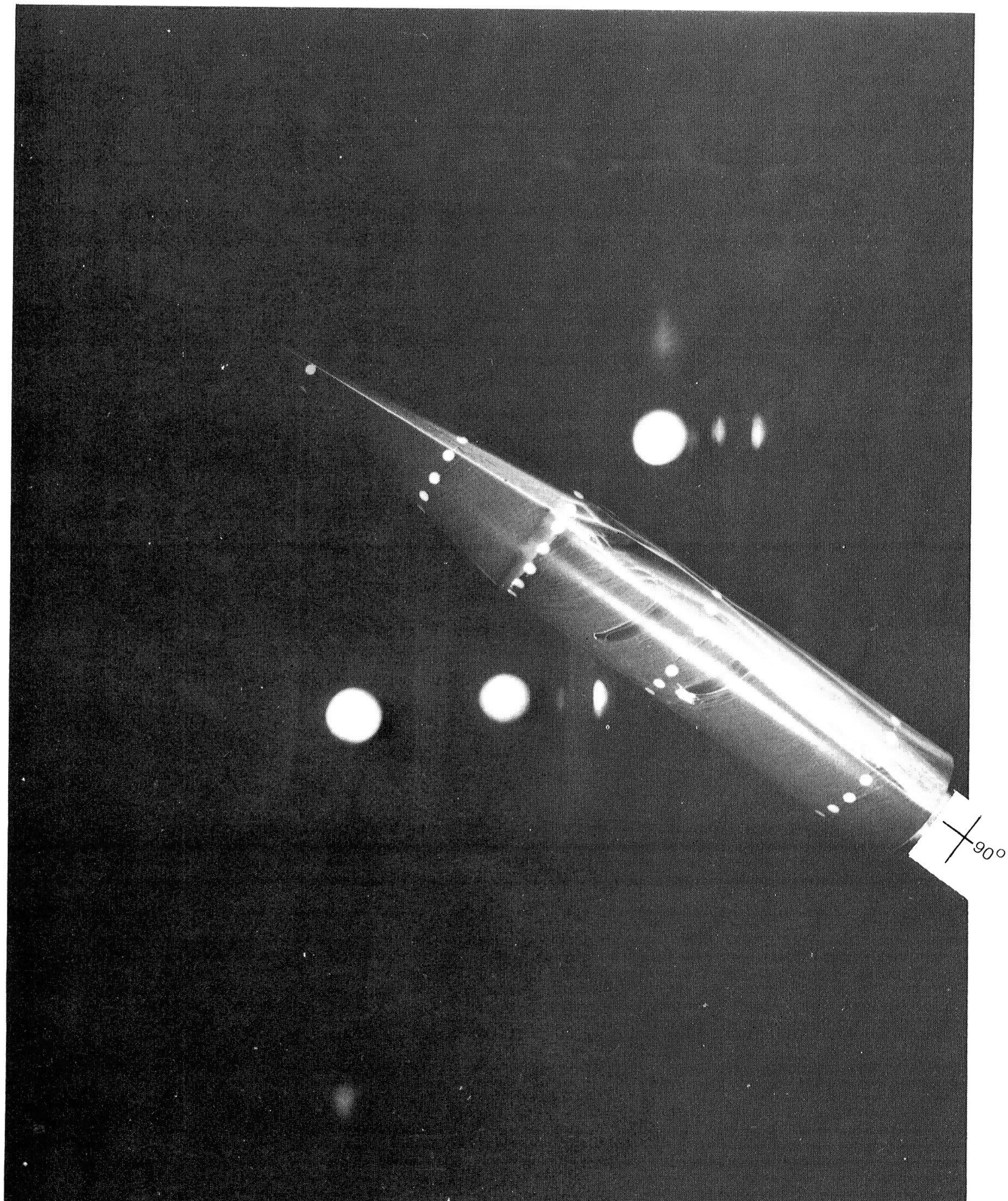
Figure 7.- Continued.



$\alpha = 28^{\circ}$

(a) Continued.

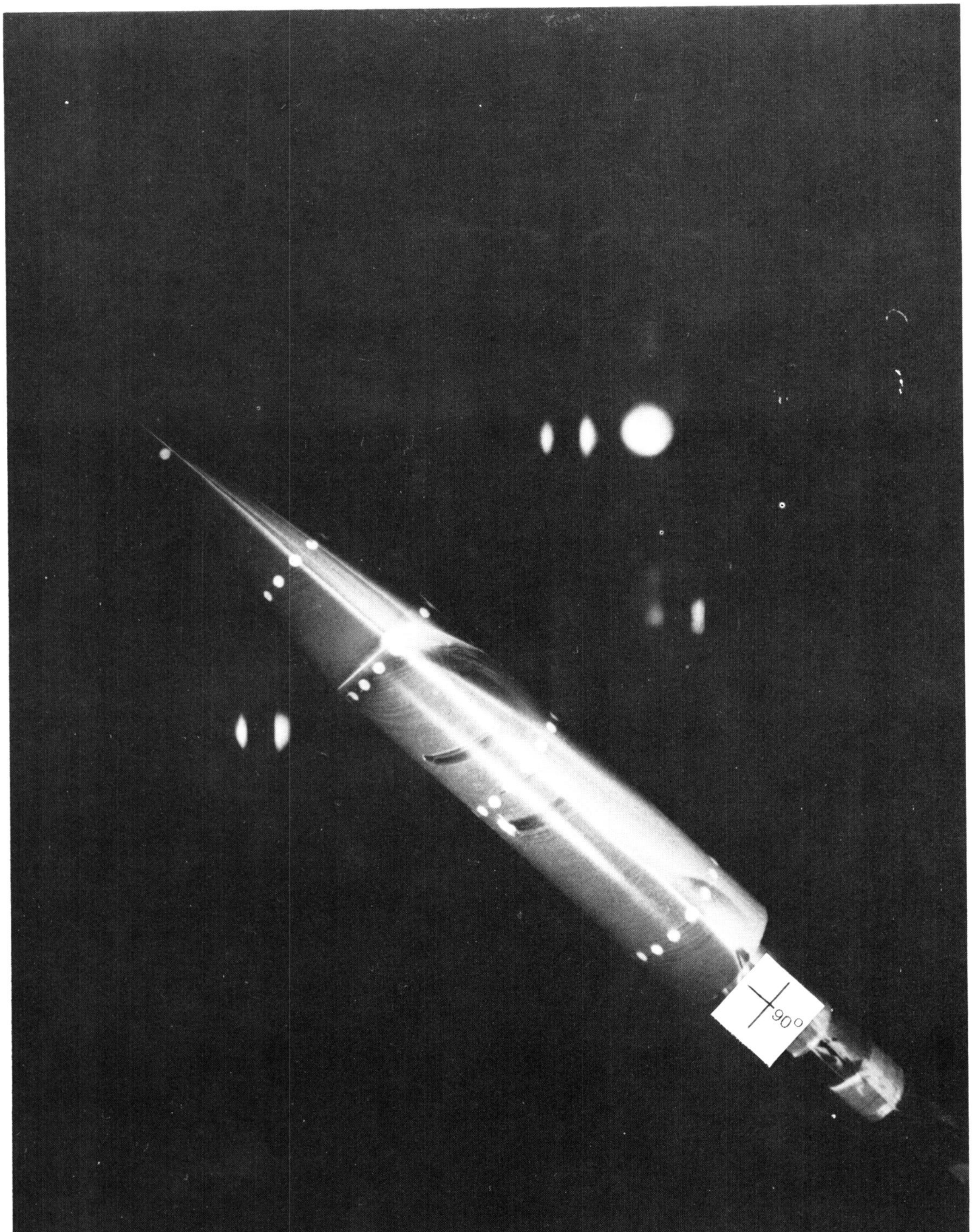
Figure 7.- Continued.



$\alpha = 36^{\circ}$

(a) Continued.

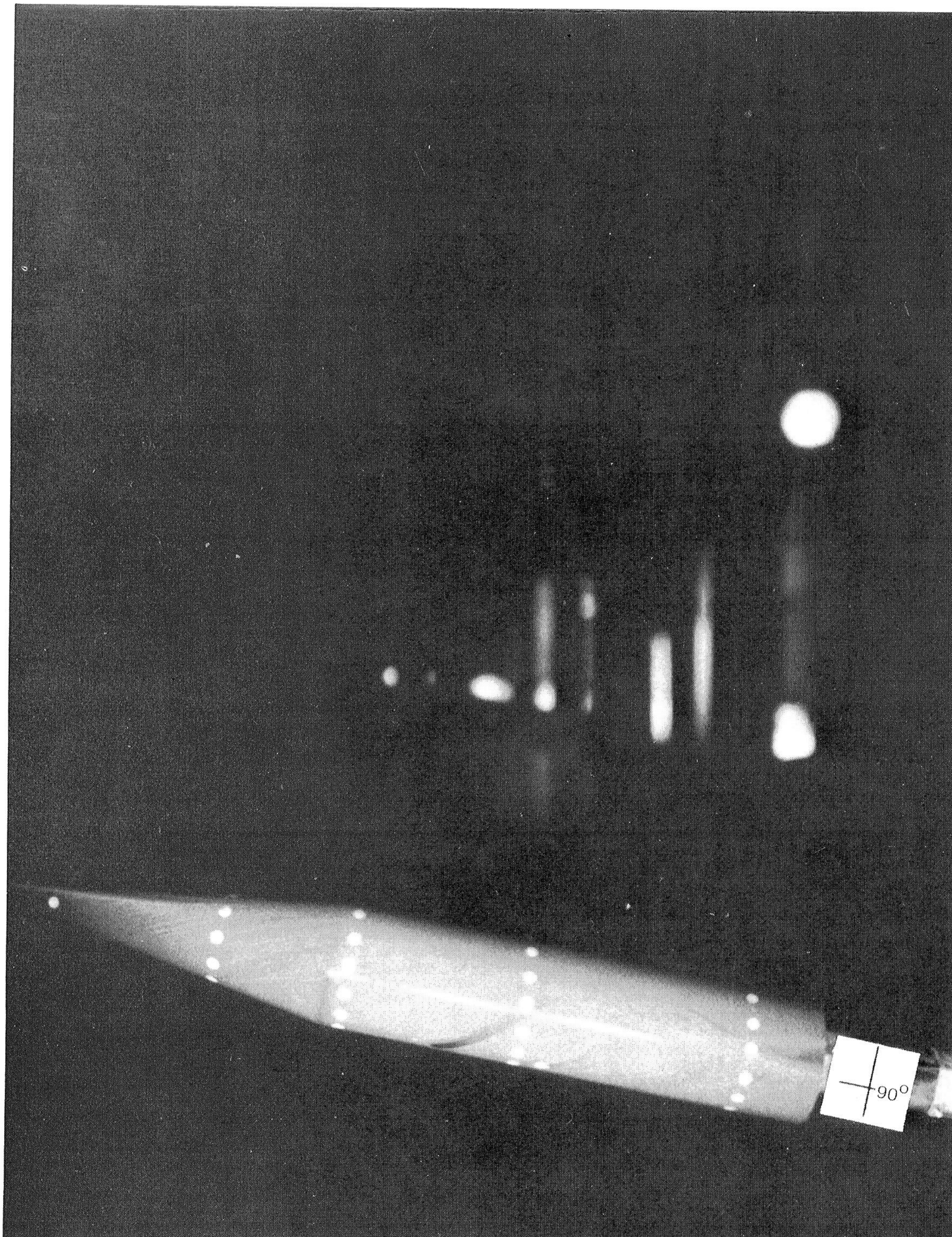
Figure 7.- Continued.



$\alpha = 44^{\circ}$

(a) Concluded.

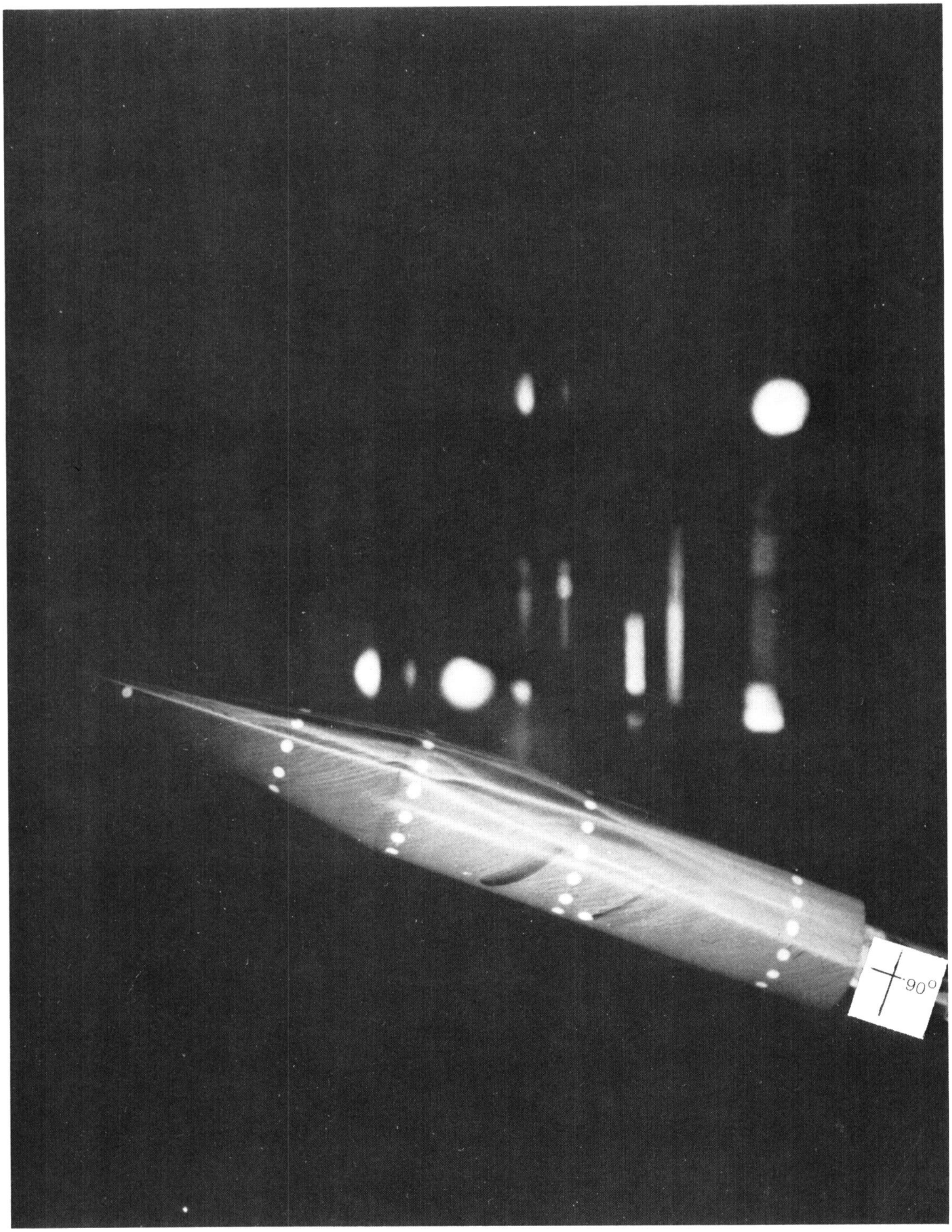
Figure 7.- Continued.



$\alpha = 12^{\circ}$

(b) $M_{\infty} = 2.3$.

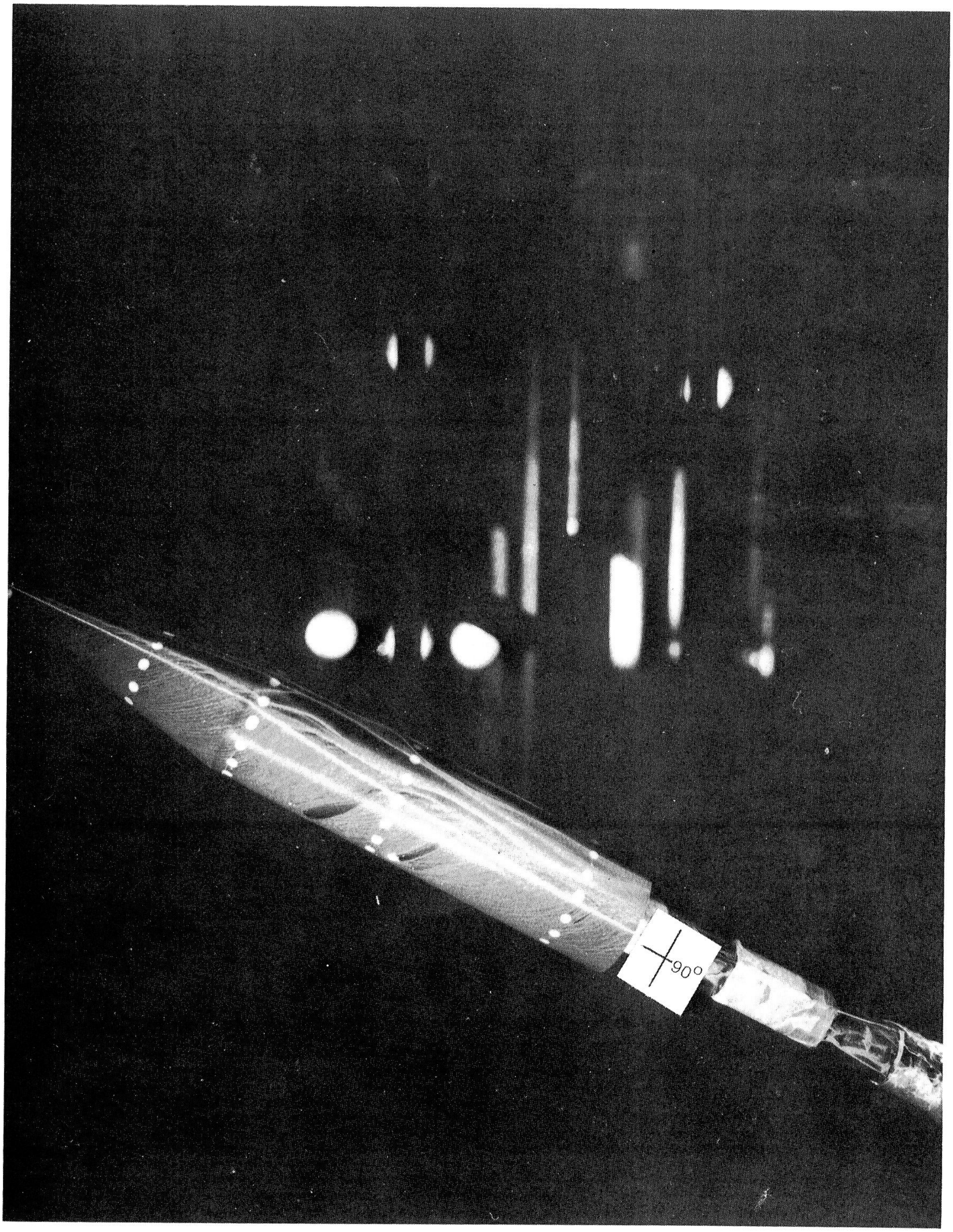
Figure 7.- Continued.



$\alpha = 20^{\circ}$

(b) Continued.

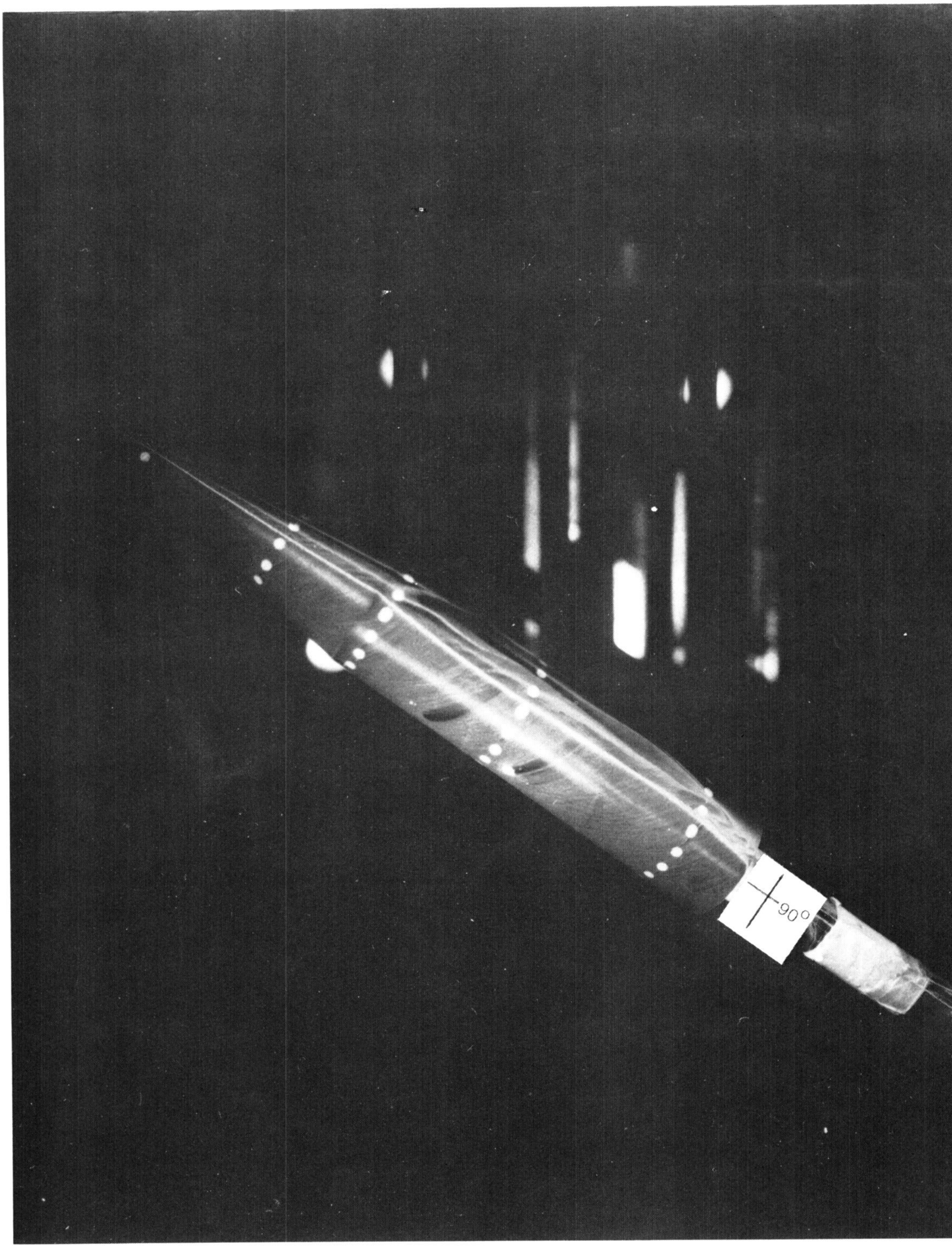
Figure 7.- Continued.



$\alpha = 28^{\circ}$

(b) Continued.

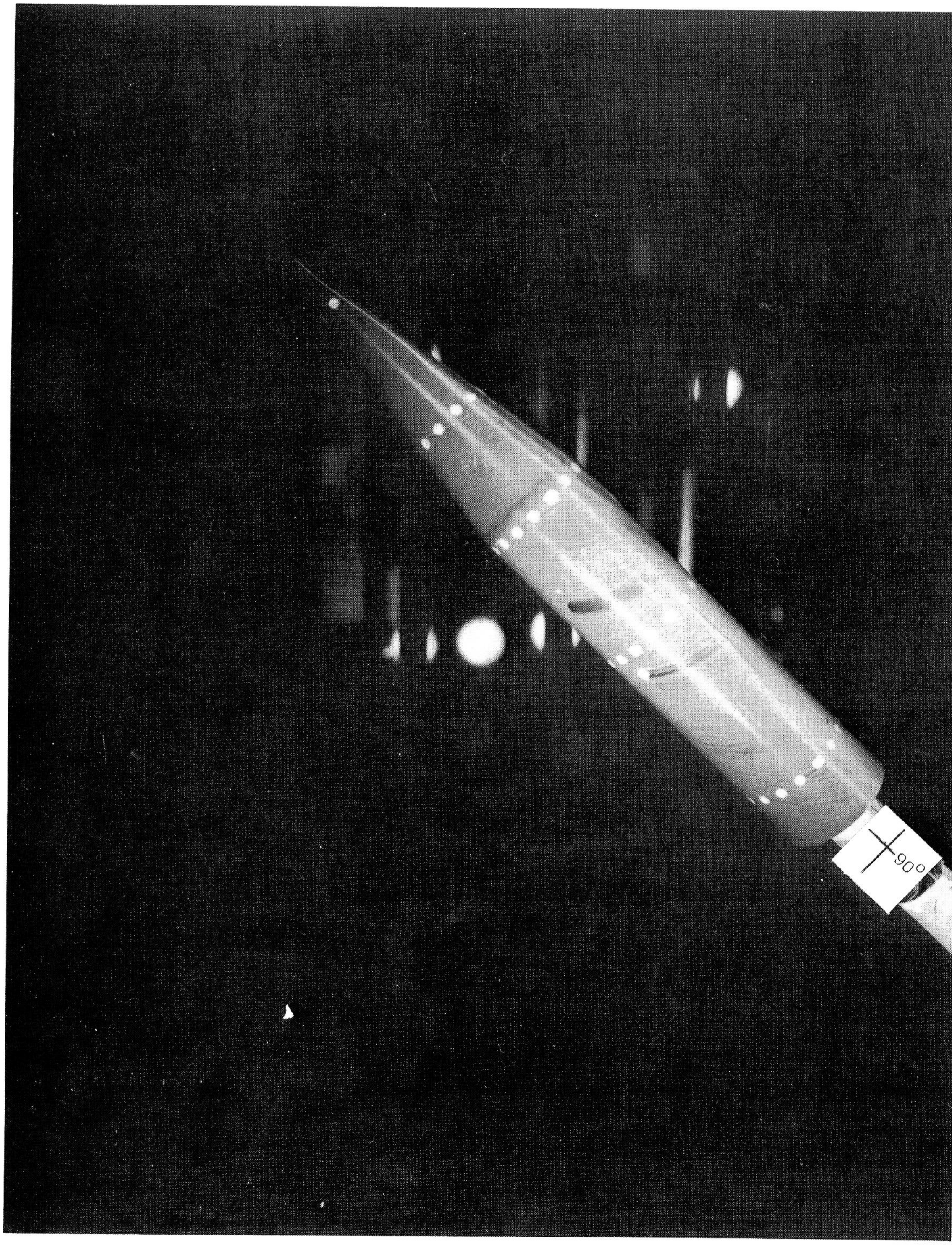
Figure 7.- Continued.



$\alpha = 36^{\circ}$

(b) Continued.

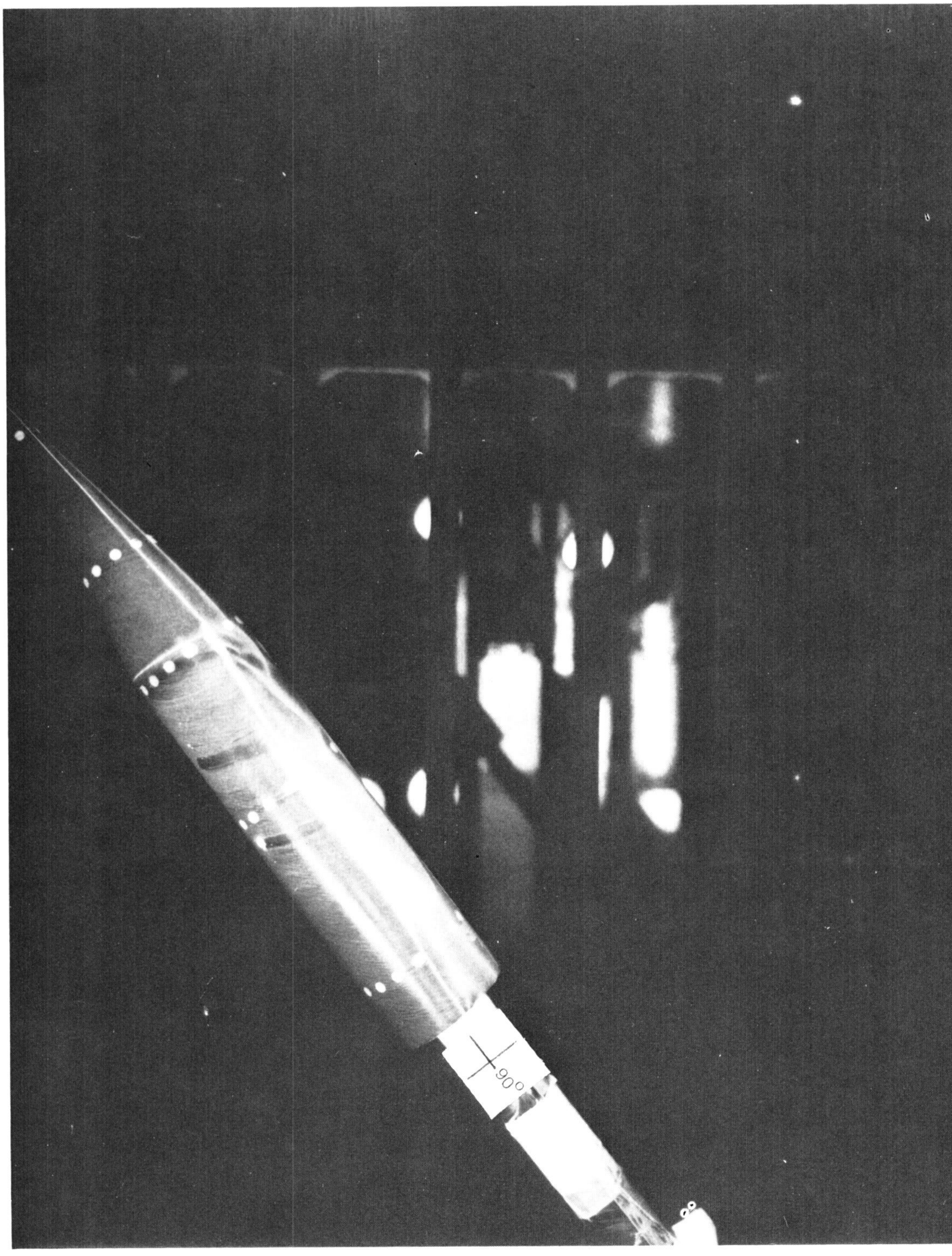
Figure 7.- Continued.



$\alpha = 44^{\circ}$

(b) Continued.

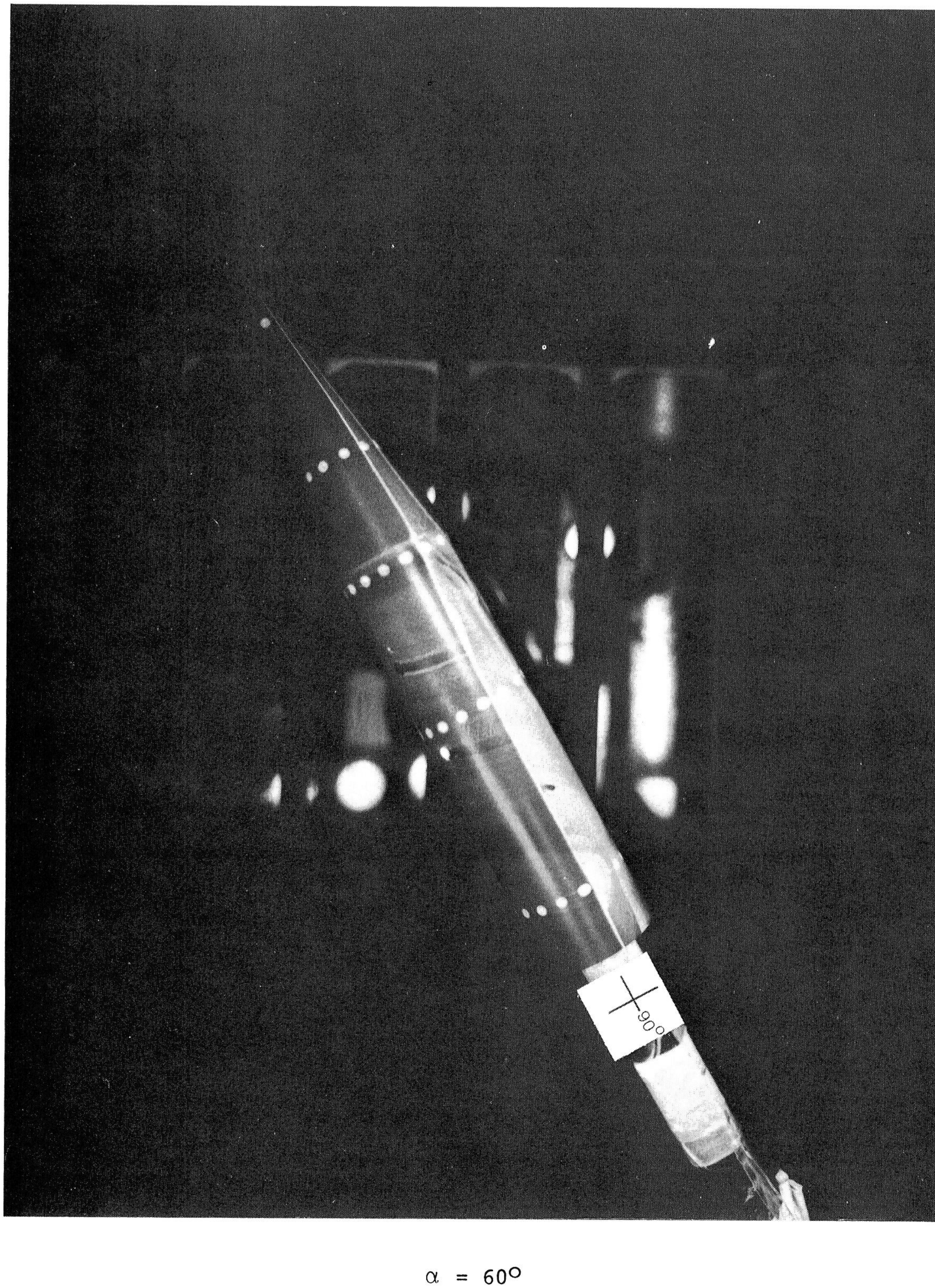
Figure 7.- Continued.



$\alpha = 52^{\circ}$

(b) Continued.

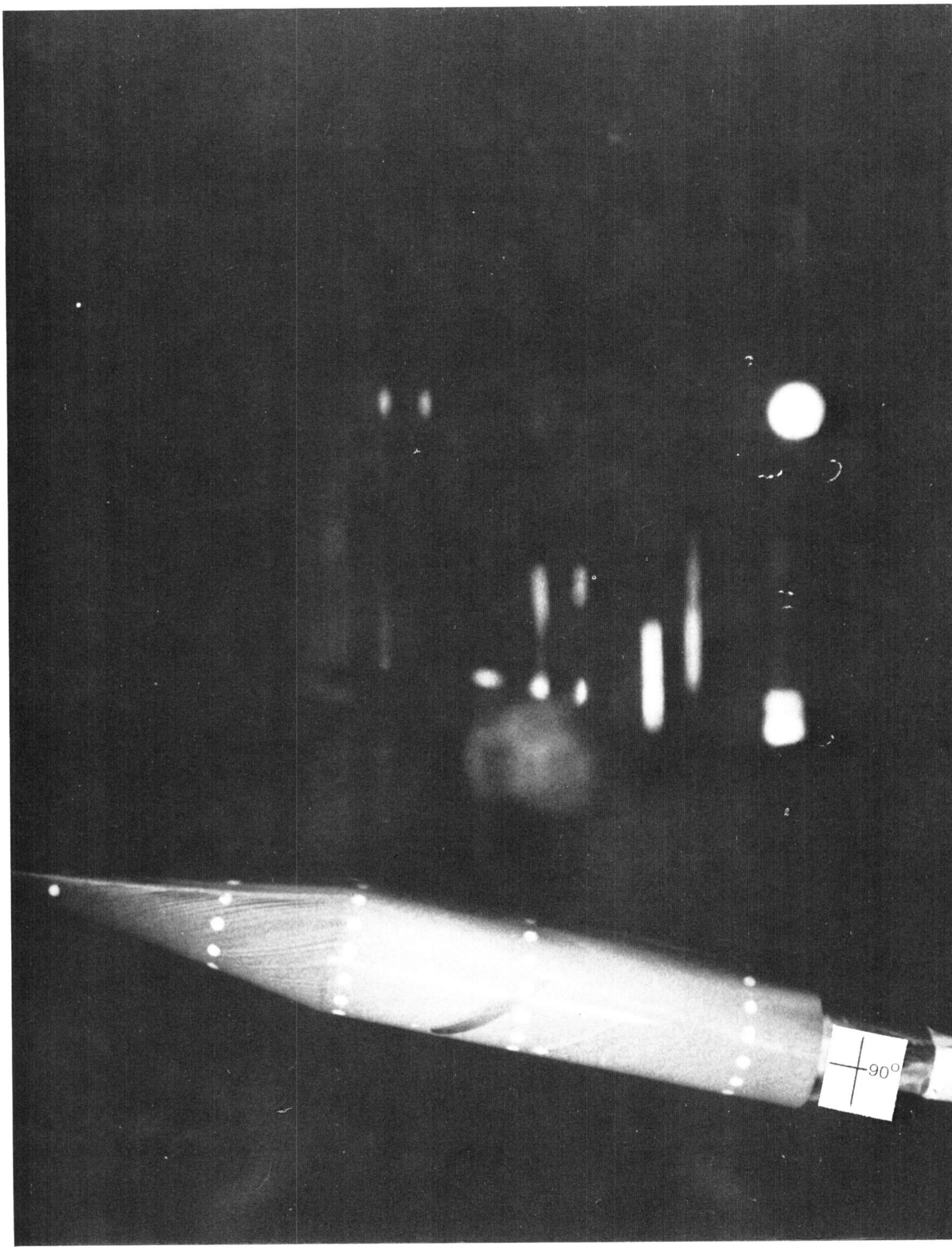
Figure 7.- Continued.



$\alpha = 60^\circ$

(b) Concluded.

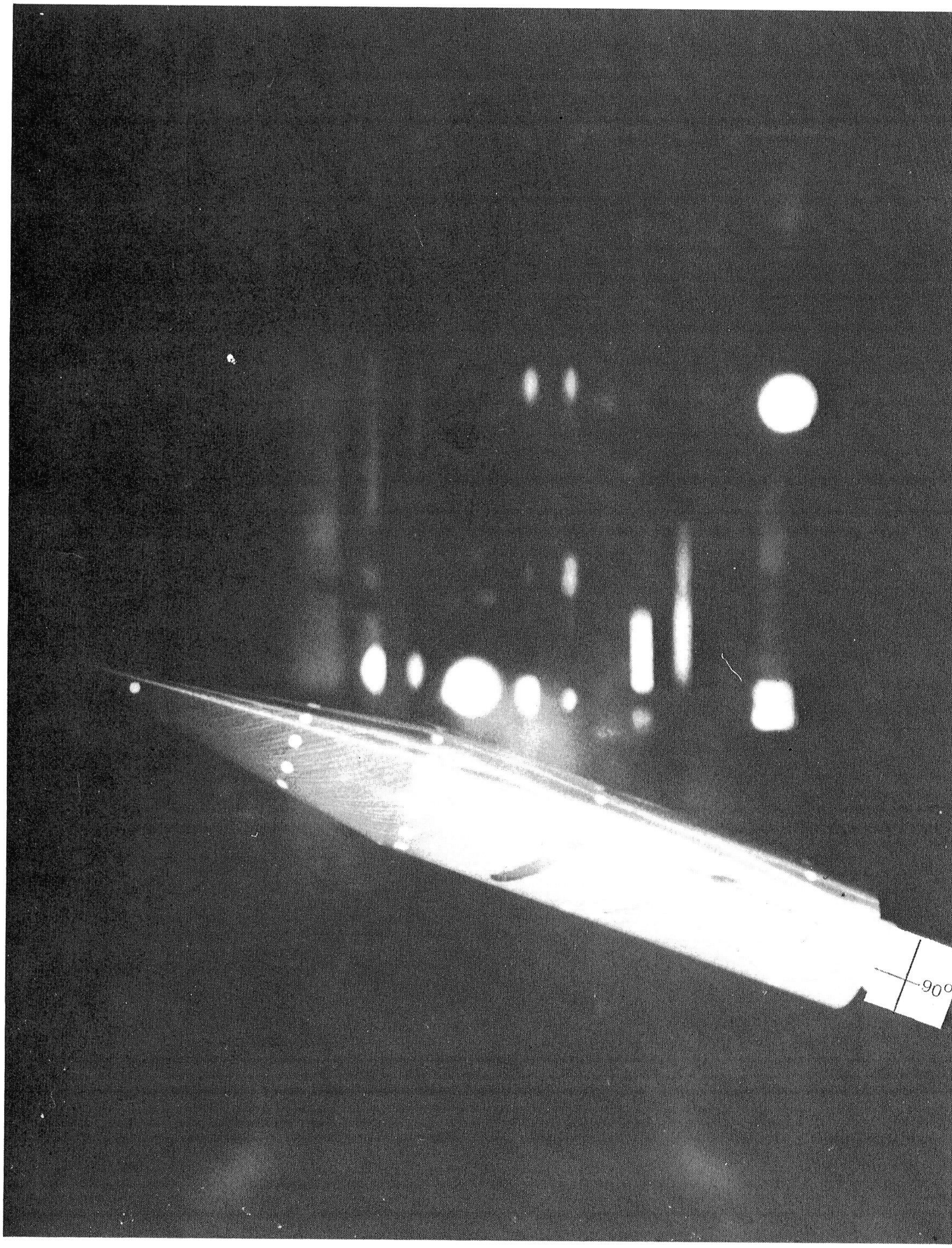
Figure 7.- Continued.



$\alpha = 12^{\circ}$

(c) $M_{\infty} = 2.96$.

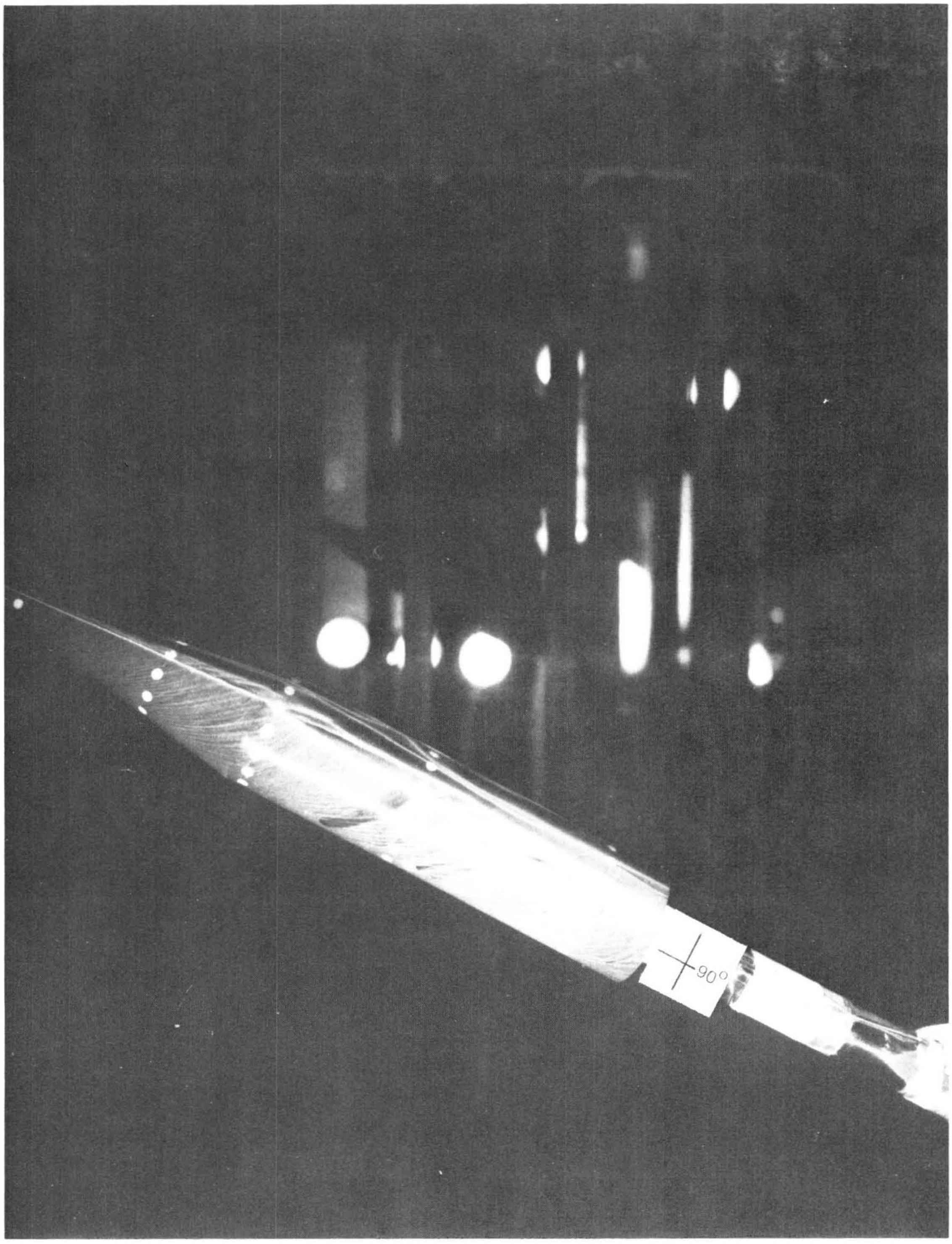
Figure 7.- Continued.



$\alpha = 20^{\circ}$

(c) Continued.

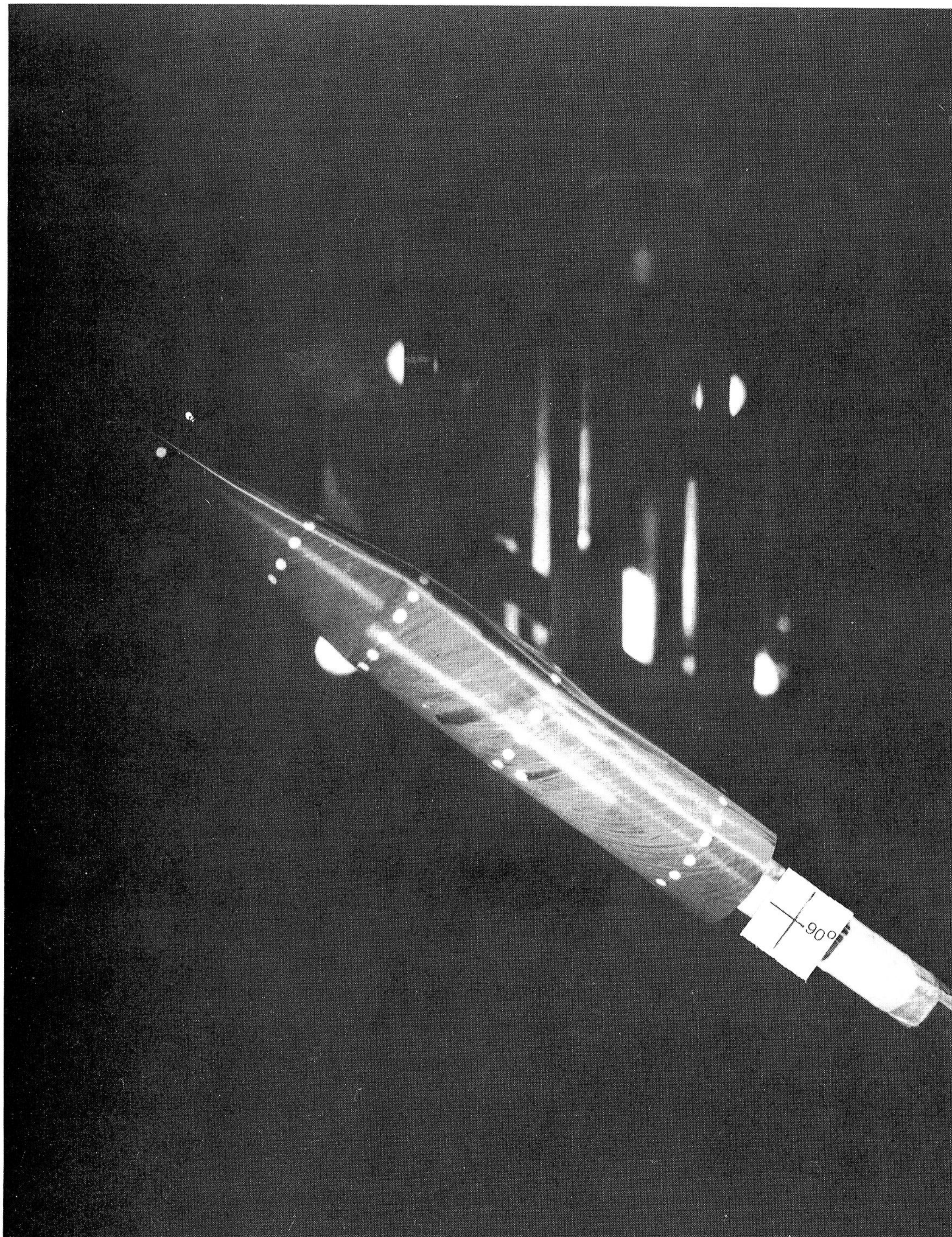
Figure 7.- Continued.



$\alpha = 28^{\circ}$

(c) Continued.

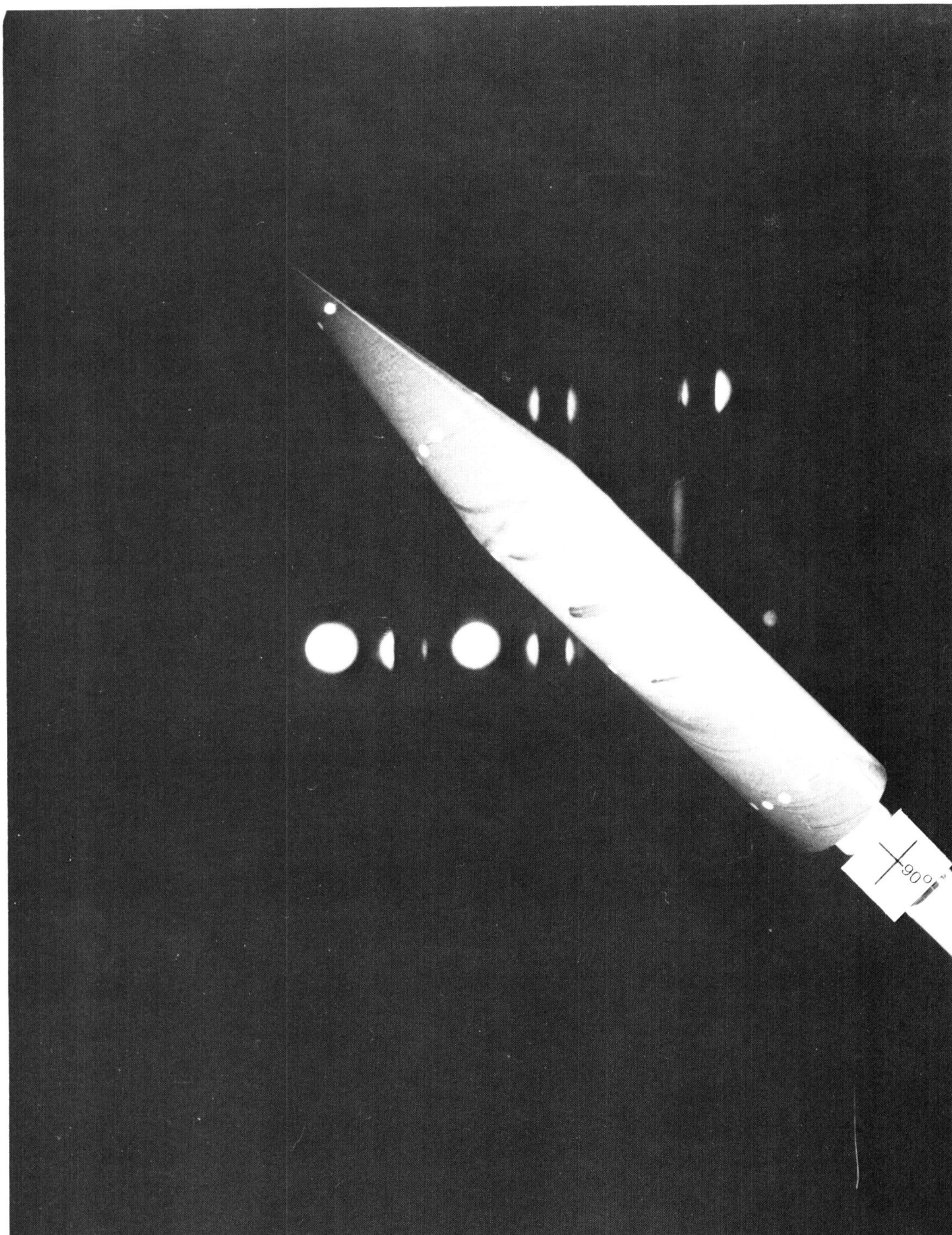
Figure 7.- Continued.



$\alpha = 36^{\circ}$

(c) Continued.

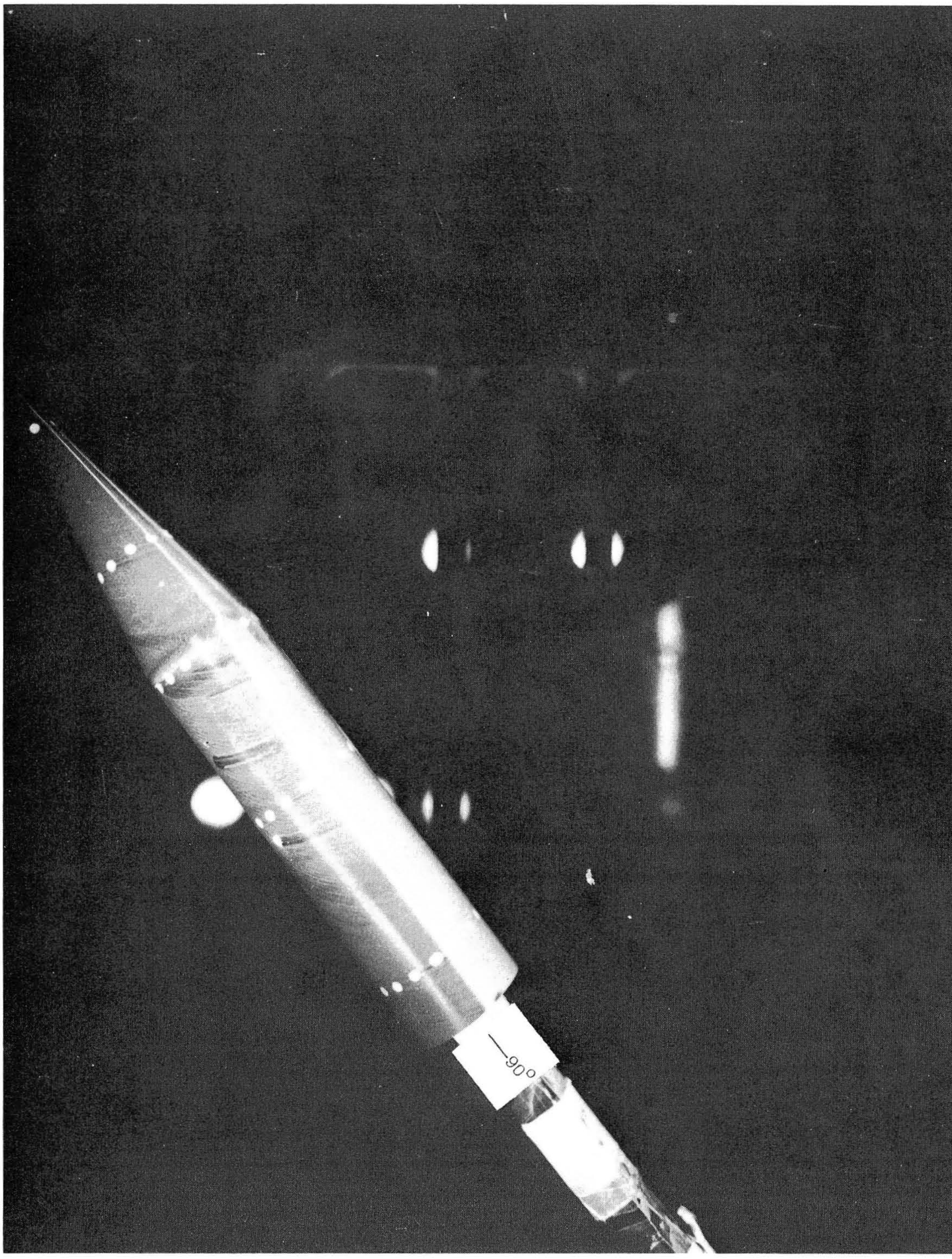
Figure 7.- Continued.



$\alpha = 44^{\circ}$

(c) Continued.

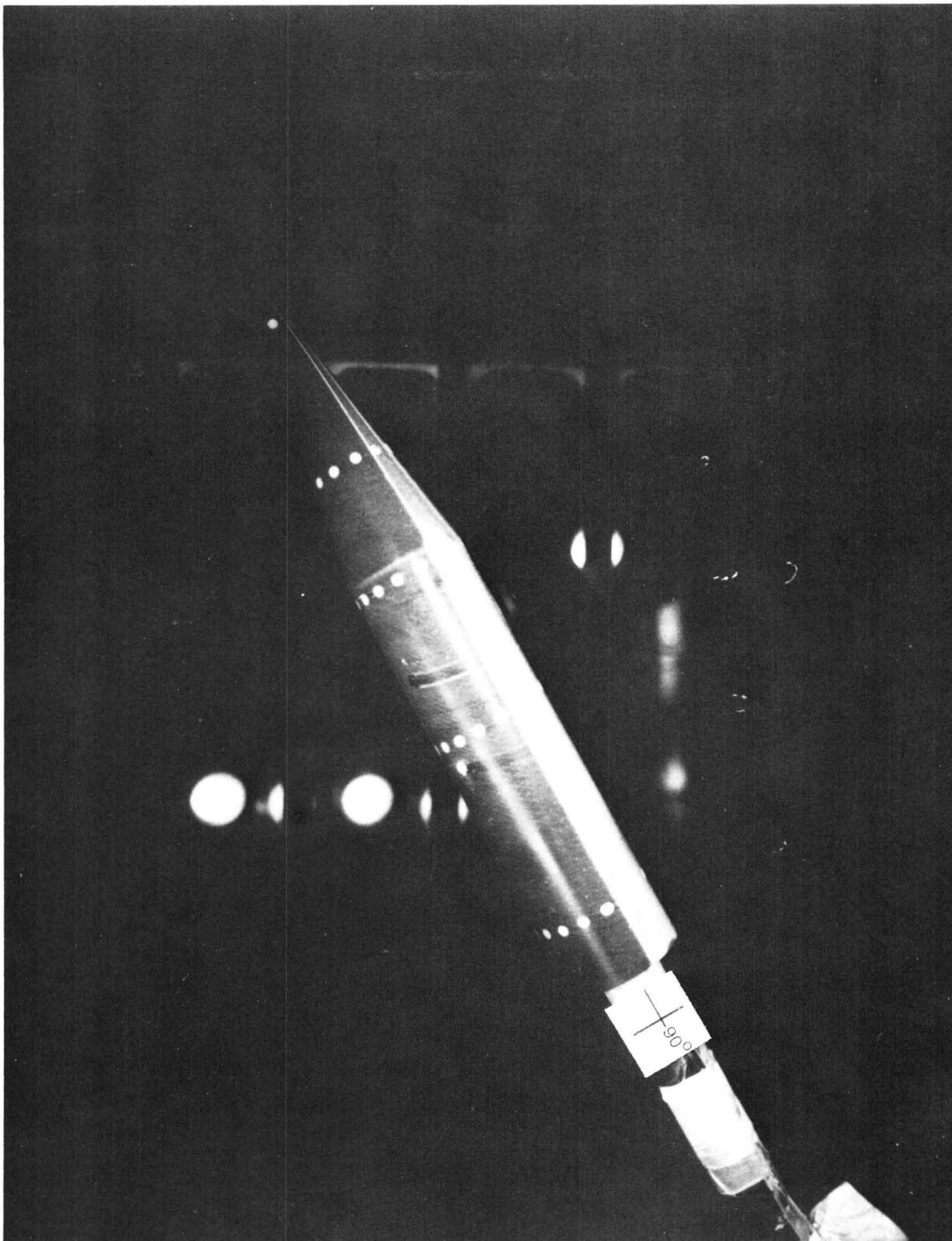
Figure 7.- Continued.



$\alpha = 52^{\circ}$

(c) Continued.

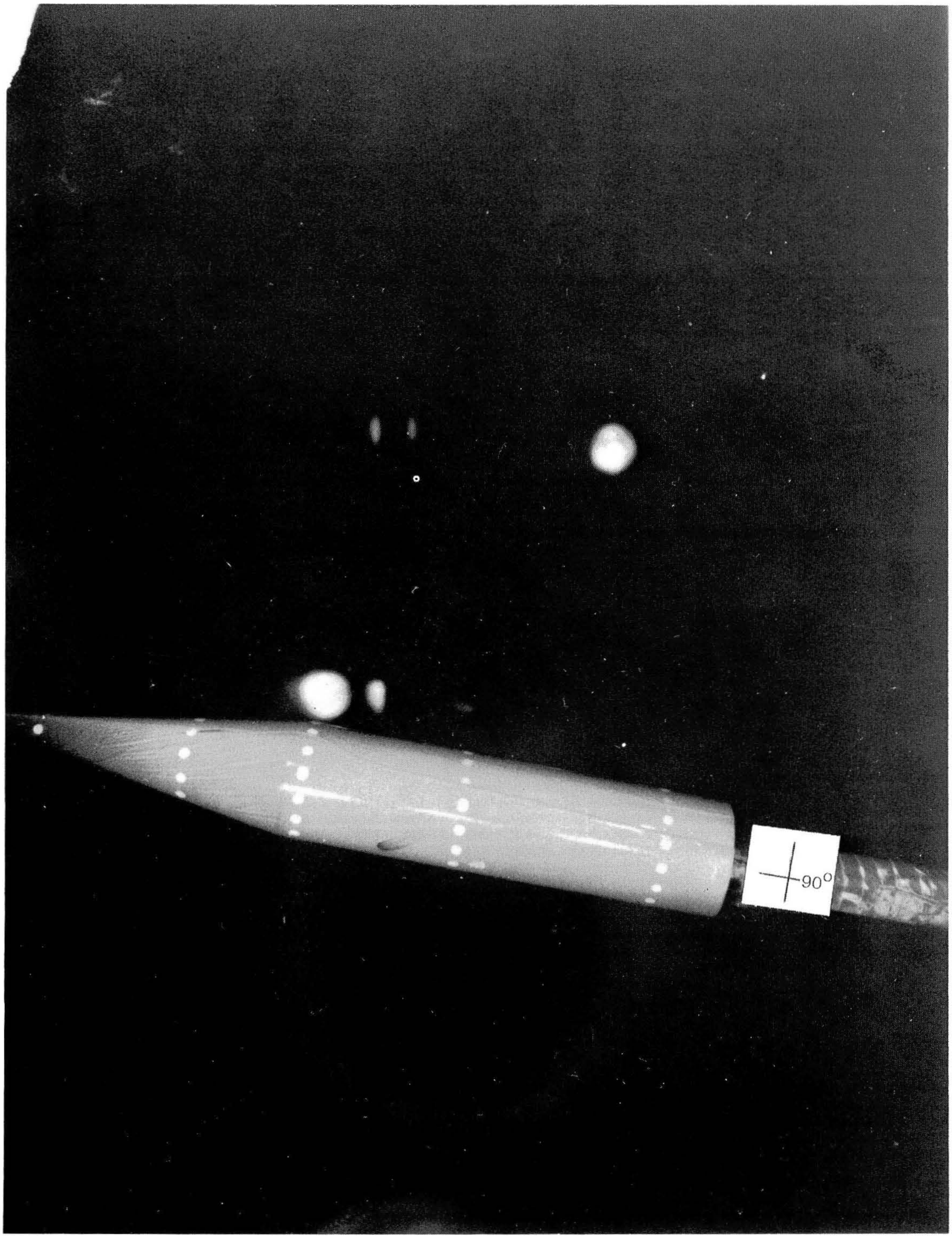
Figure 7.- Continued.



$\alpha = 60^{\circ}$

(c) Concluded.

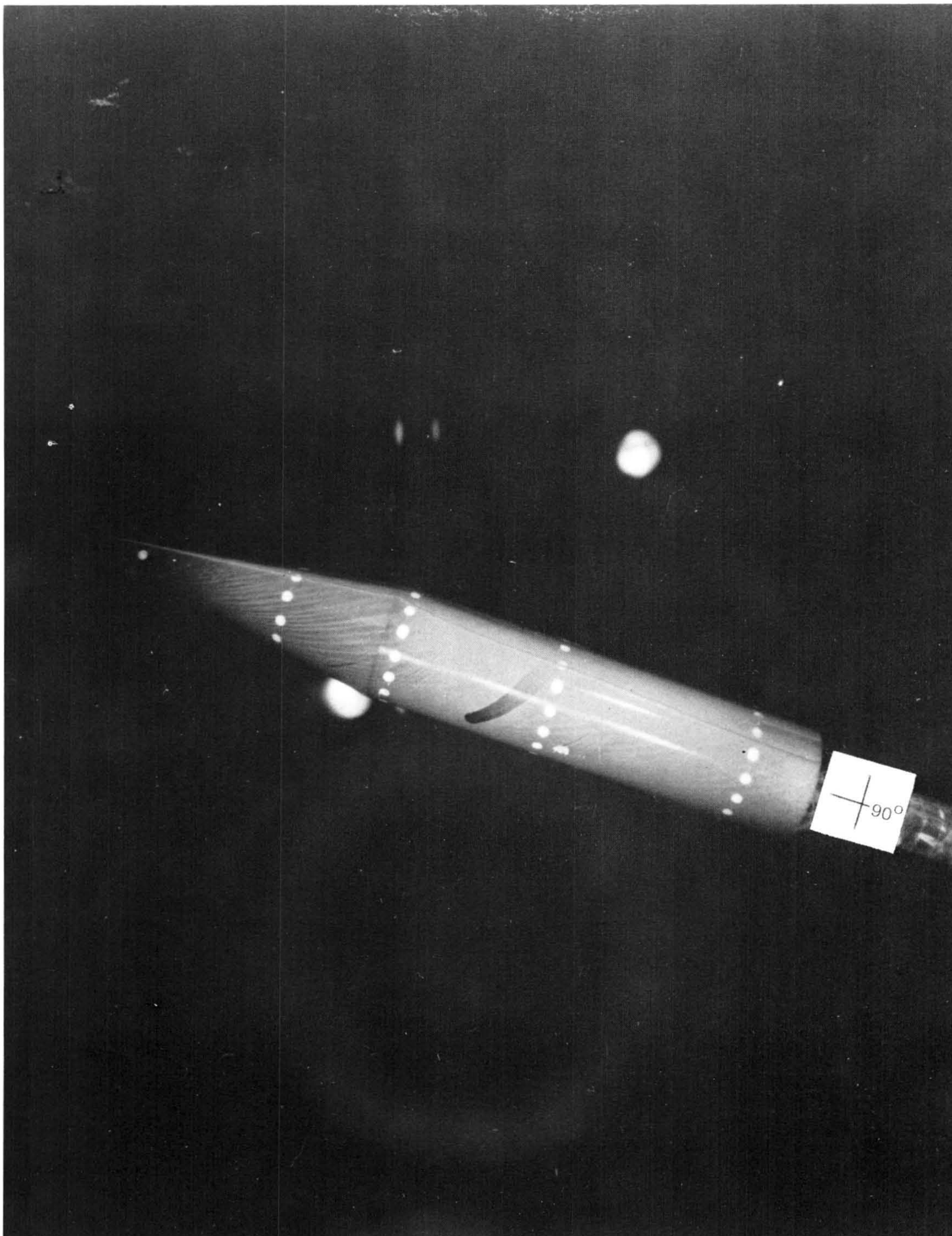
Figure 7.- Continued.



$\alpha = 12^{\circ}$

(d) $M_{\infty} = 4.63$.

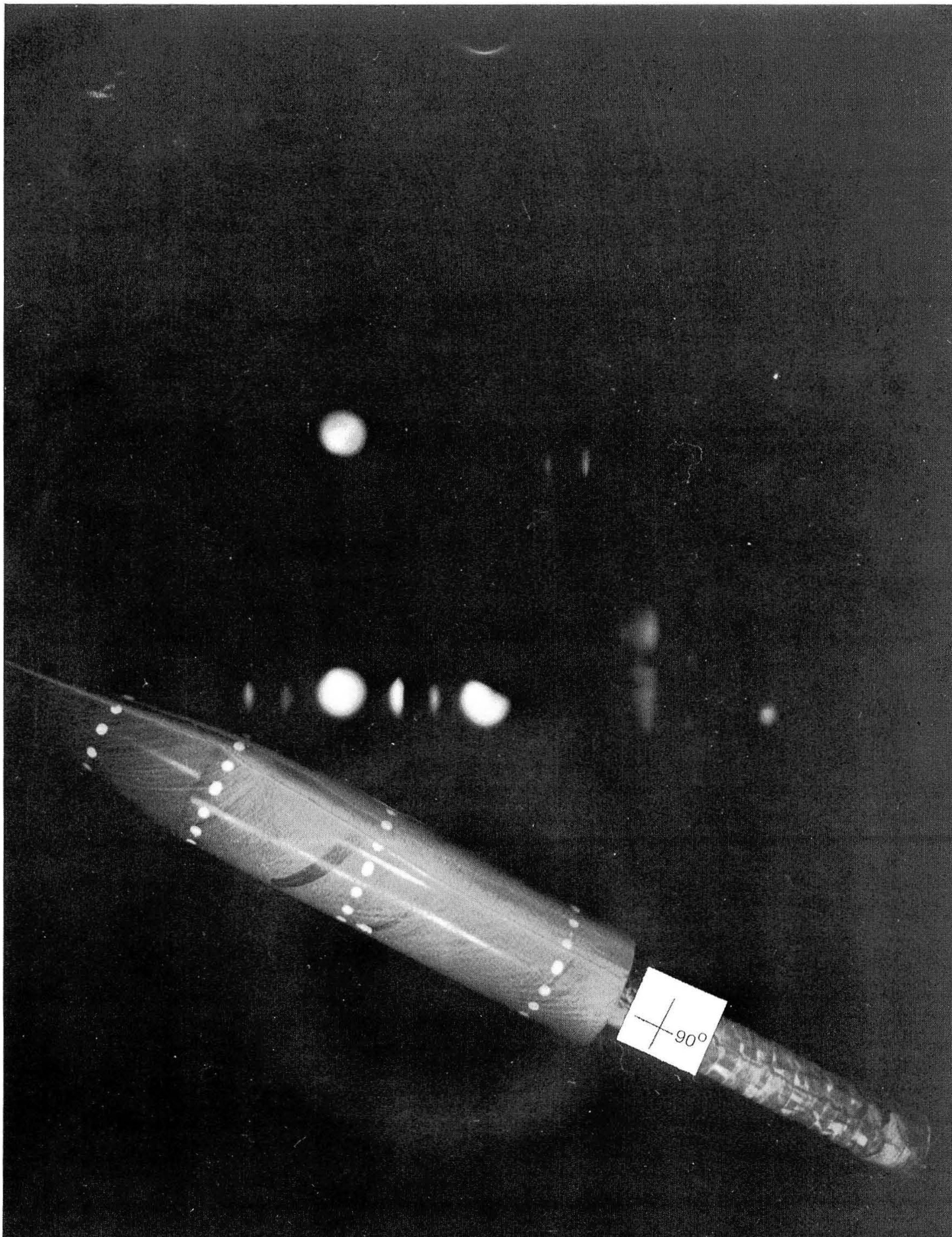
Figure 7.- Continued.



$\alpha = 20^{\circ}$

(d) Continued.

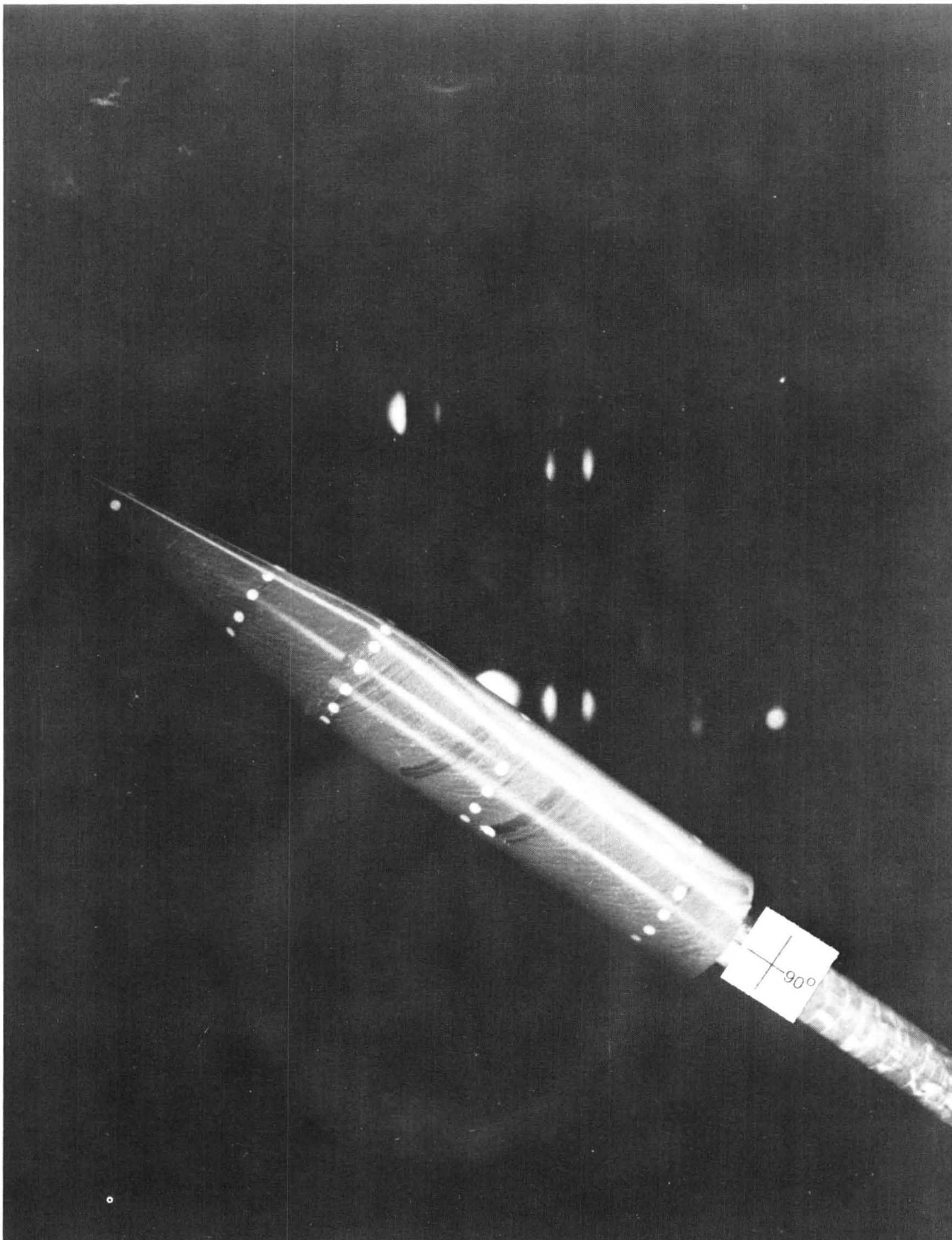
Figure 7.- Continued.



$\alpha = 28^{\circ}$

(d) Continued.

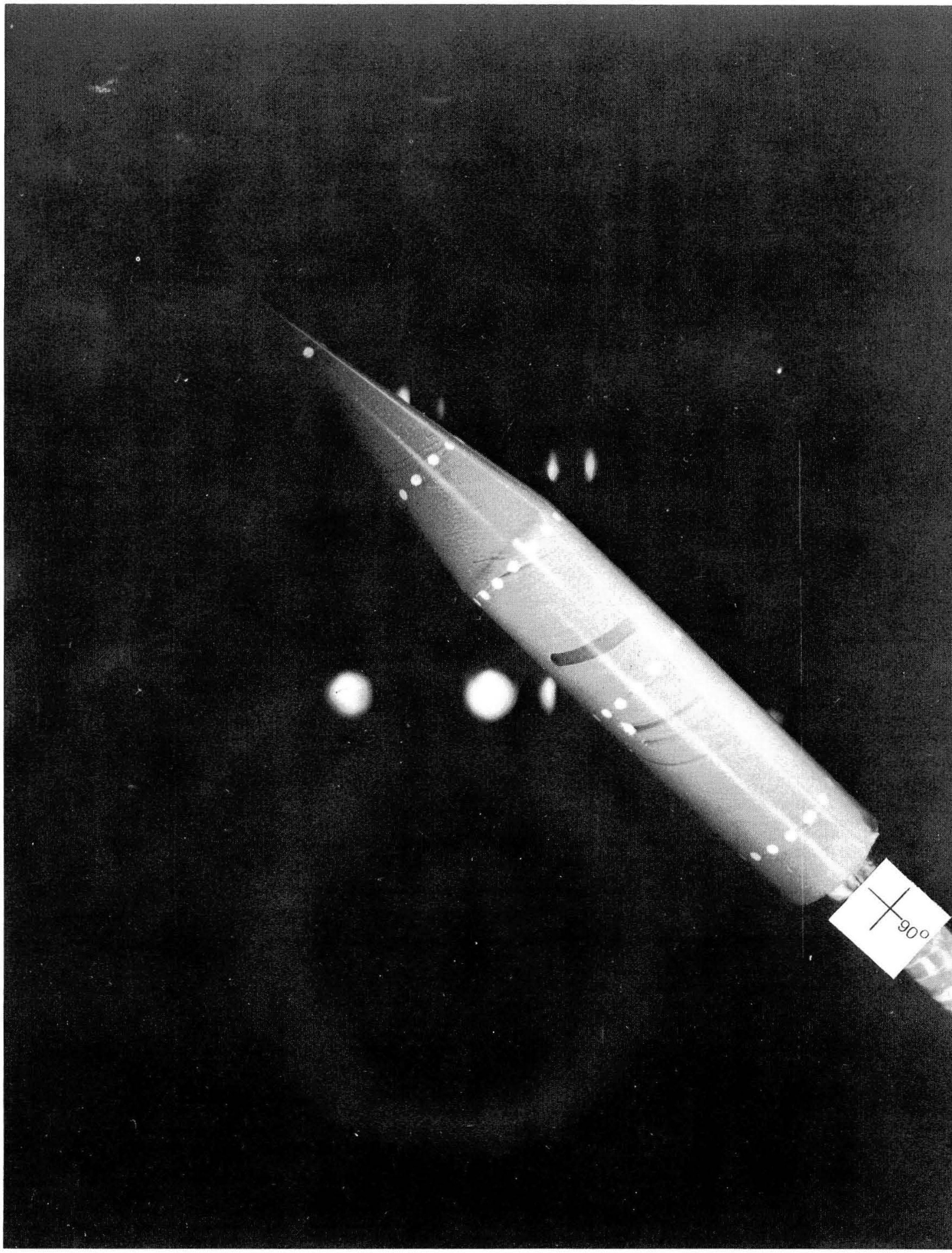
Figure 7.- Continued.



$\alpha = 36^{\circ}$

(d) Continued.

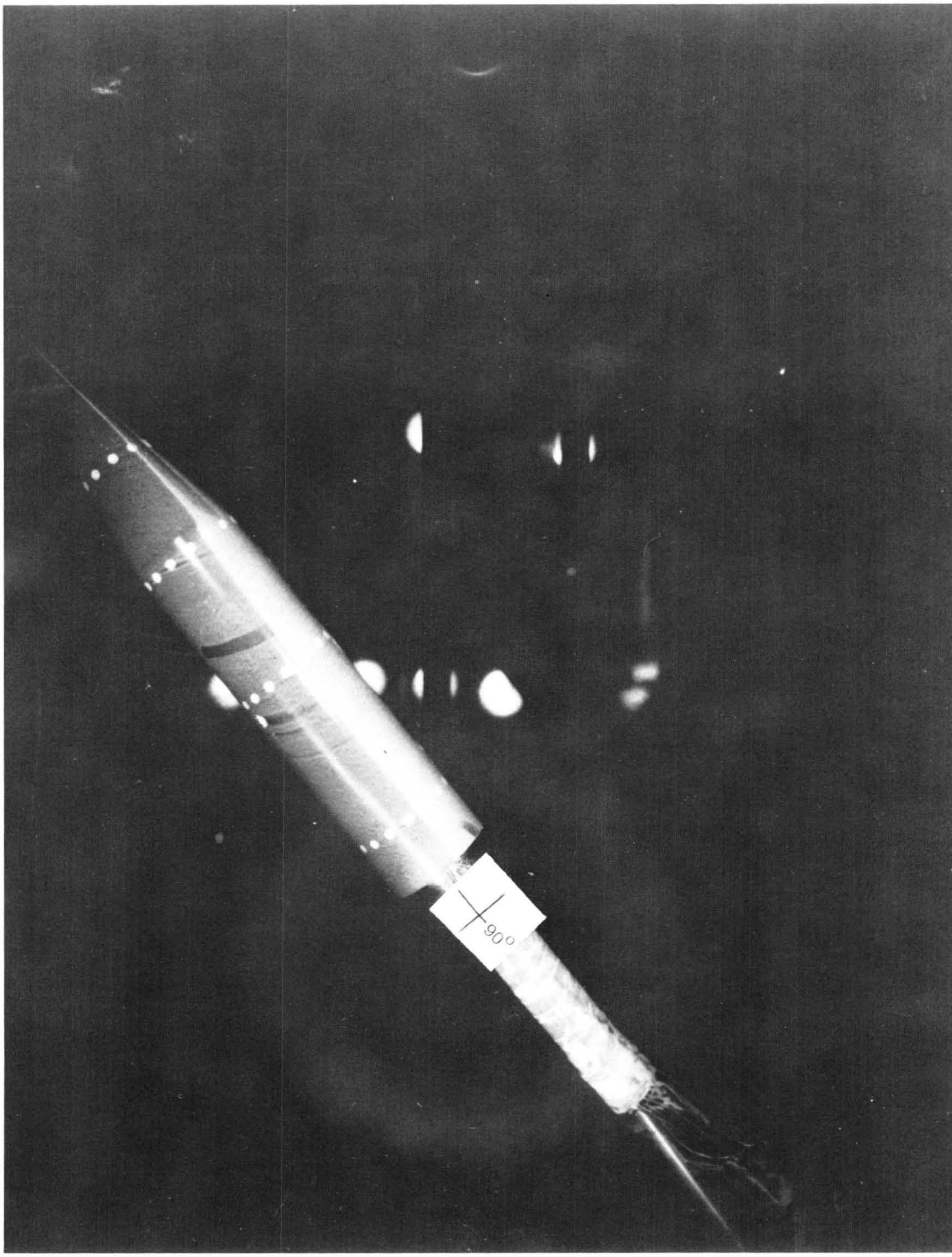
Figure 7.- Continued.



$\alpha = 44^{\circ}$

(d) Continued.

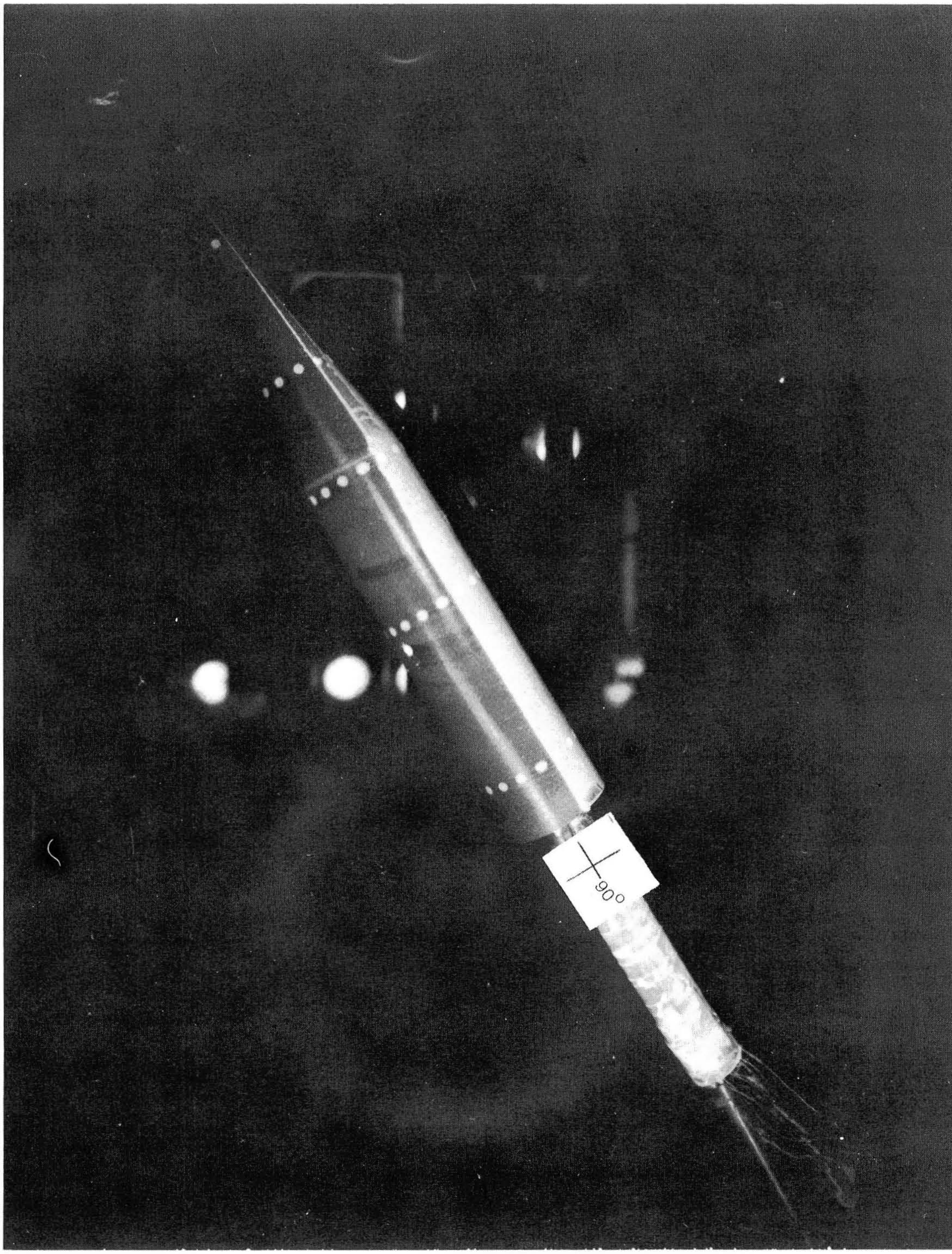
Figure 7.- Continued.



$\alpha = 52^{\circ}$

(d) Continued.

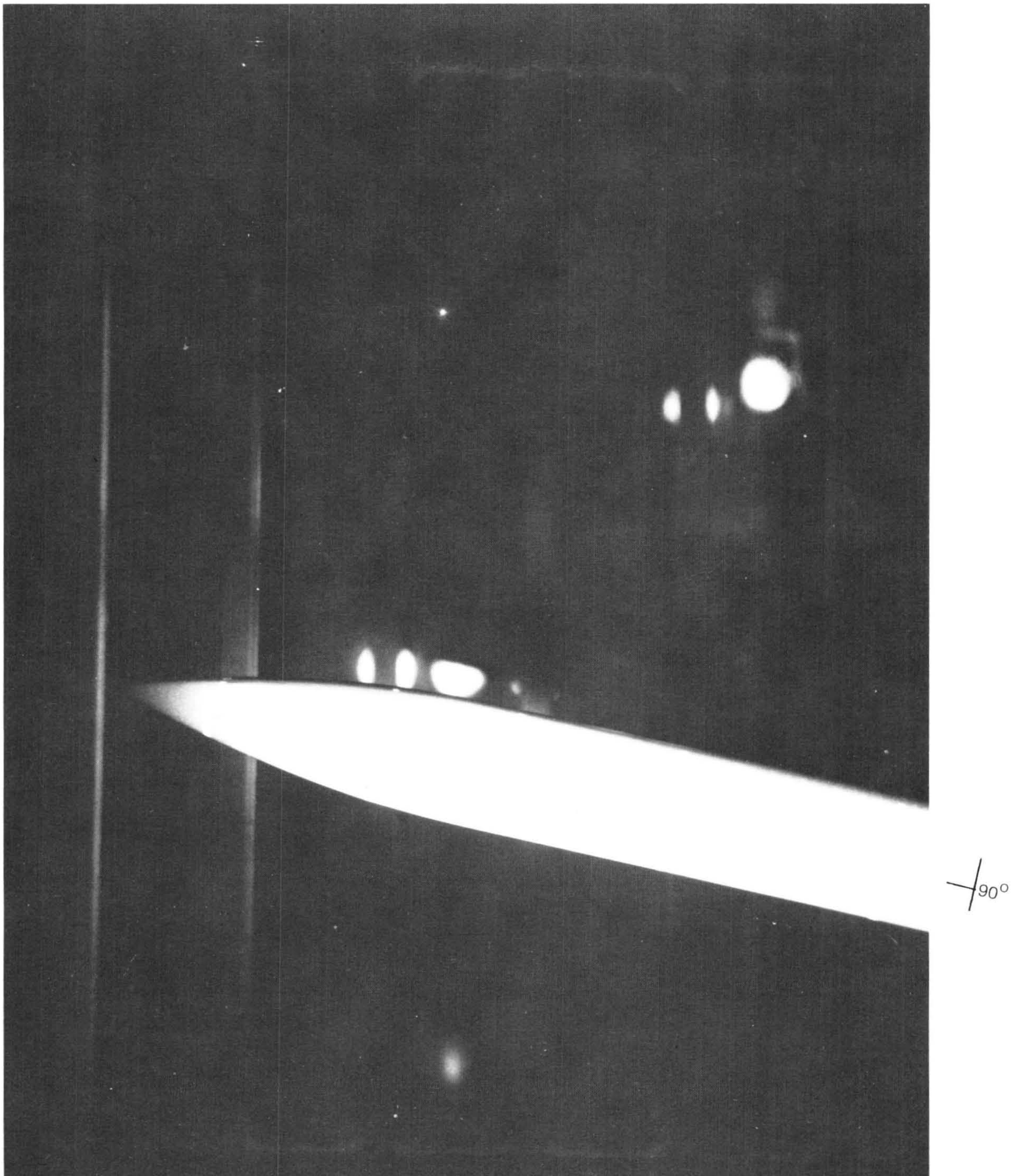
Figure 7.- Continued.



$\alpha = 60^{\circ}$

(d) Concluded.

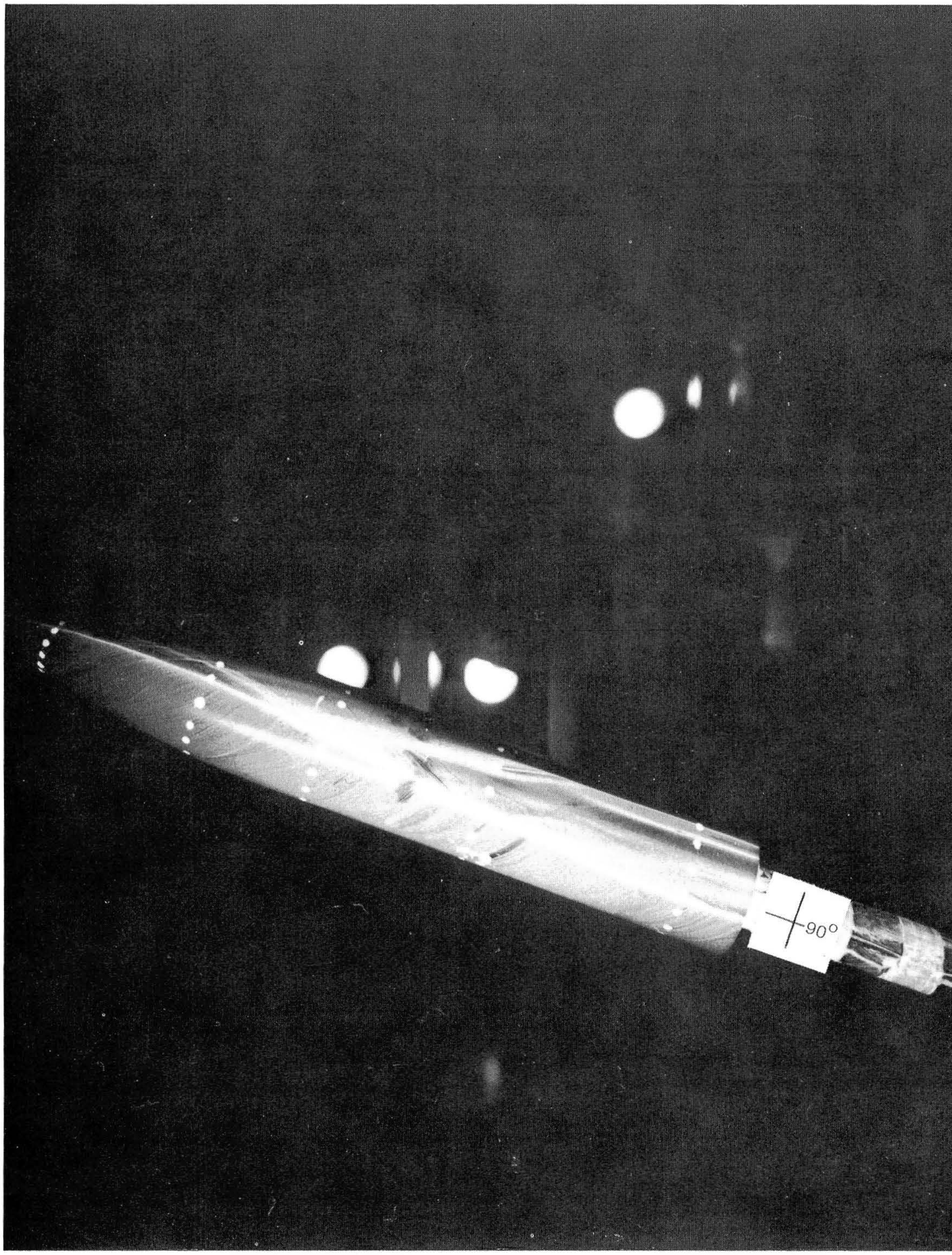
Figure 7.- Concluded.



$\alpha = 12^{\circ}$

(a) $M_{\infty} = 1.6$.

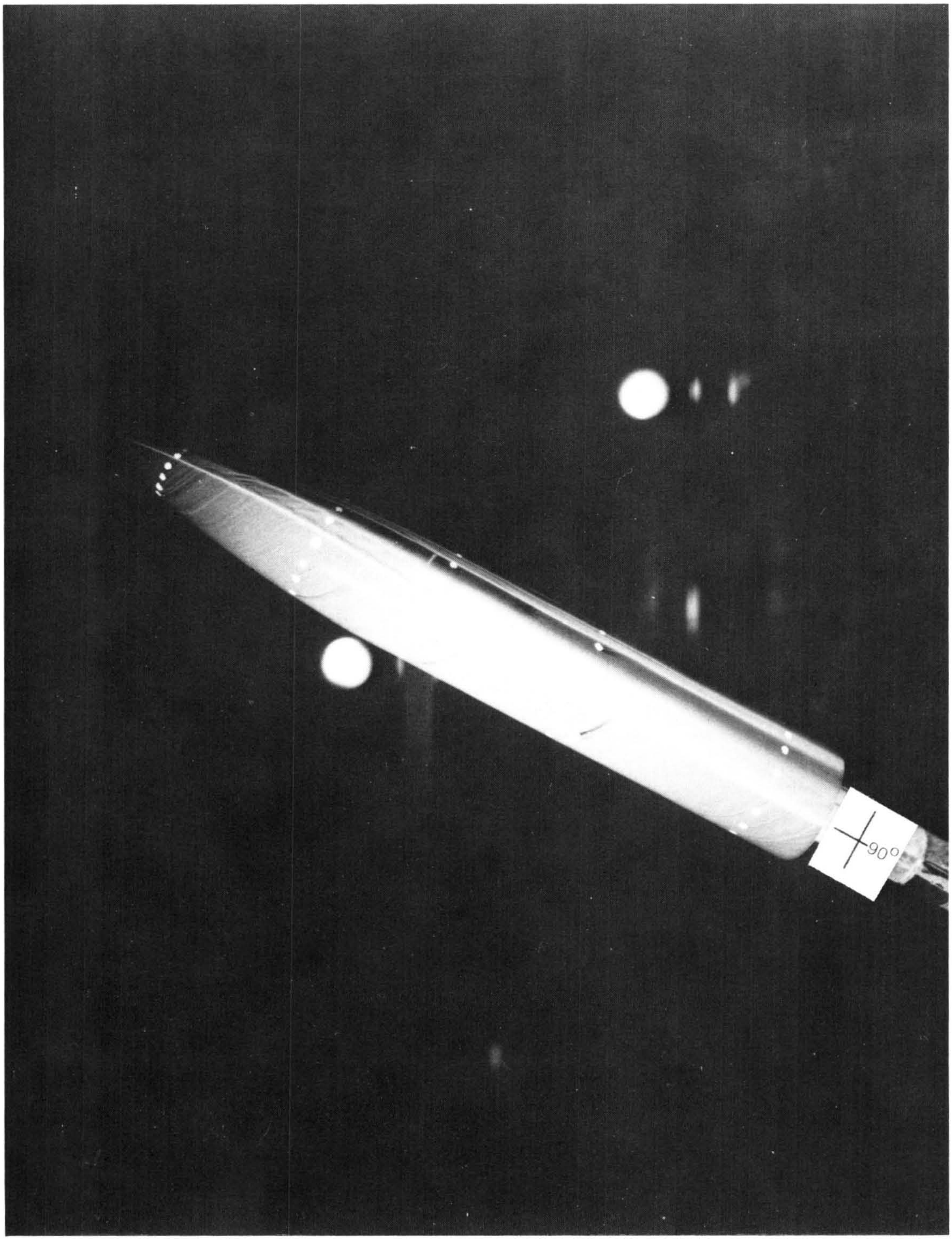
Figure 8.- Oil-flow photographs for circular-arc—cylinder model.



$\alpha = 20^{\circ}$

(a) Continued.

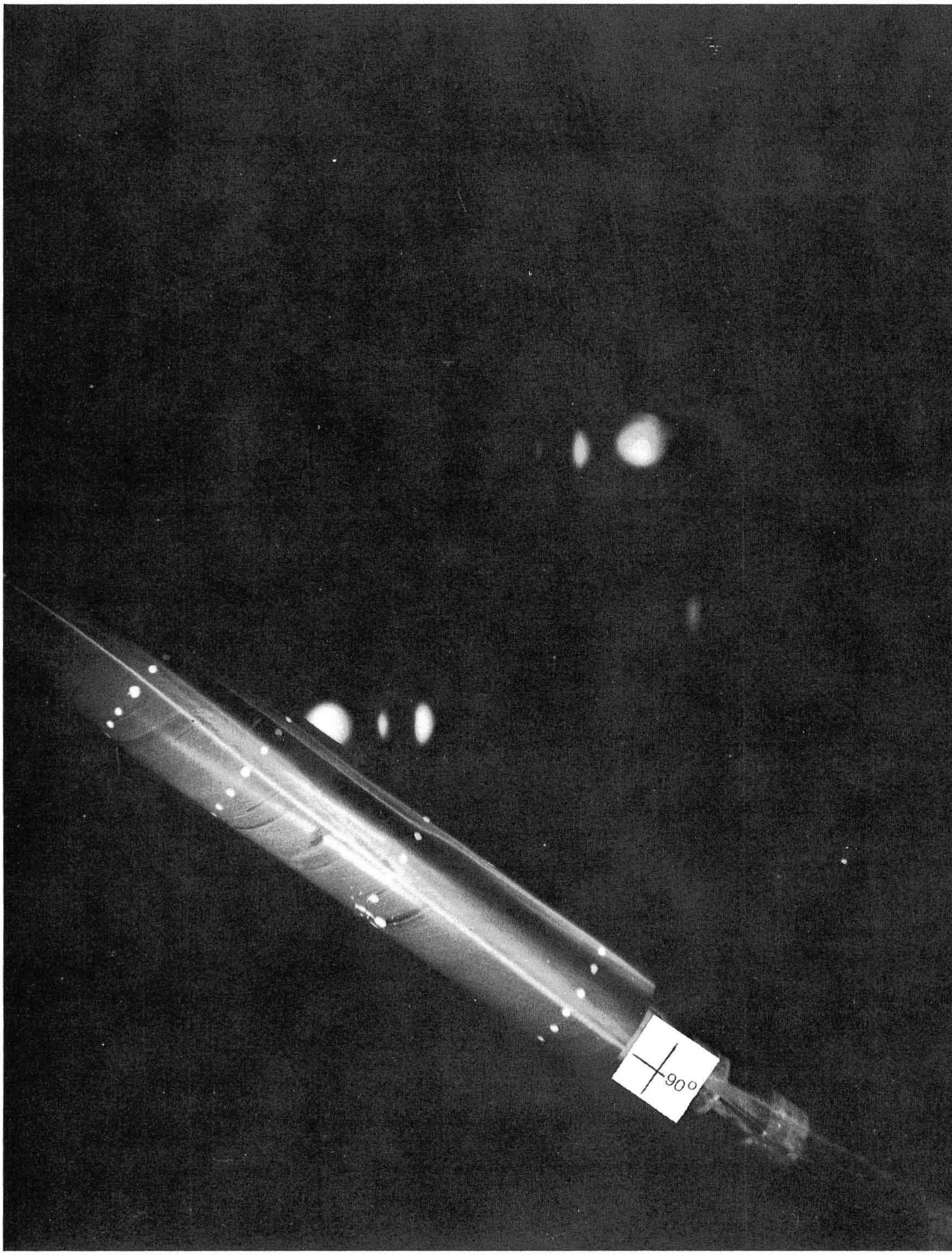
Figure 8.- Continued.



$\alpha = 28^{\circ}$

(a) Continued.

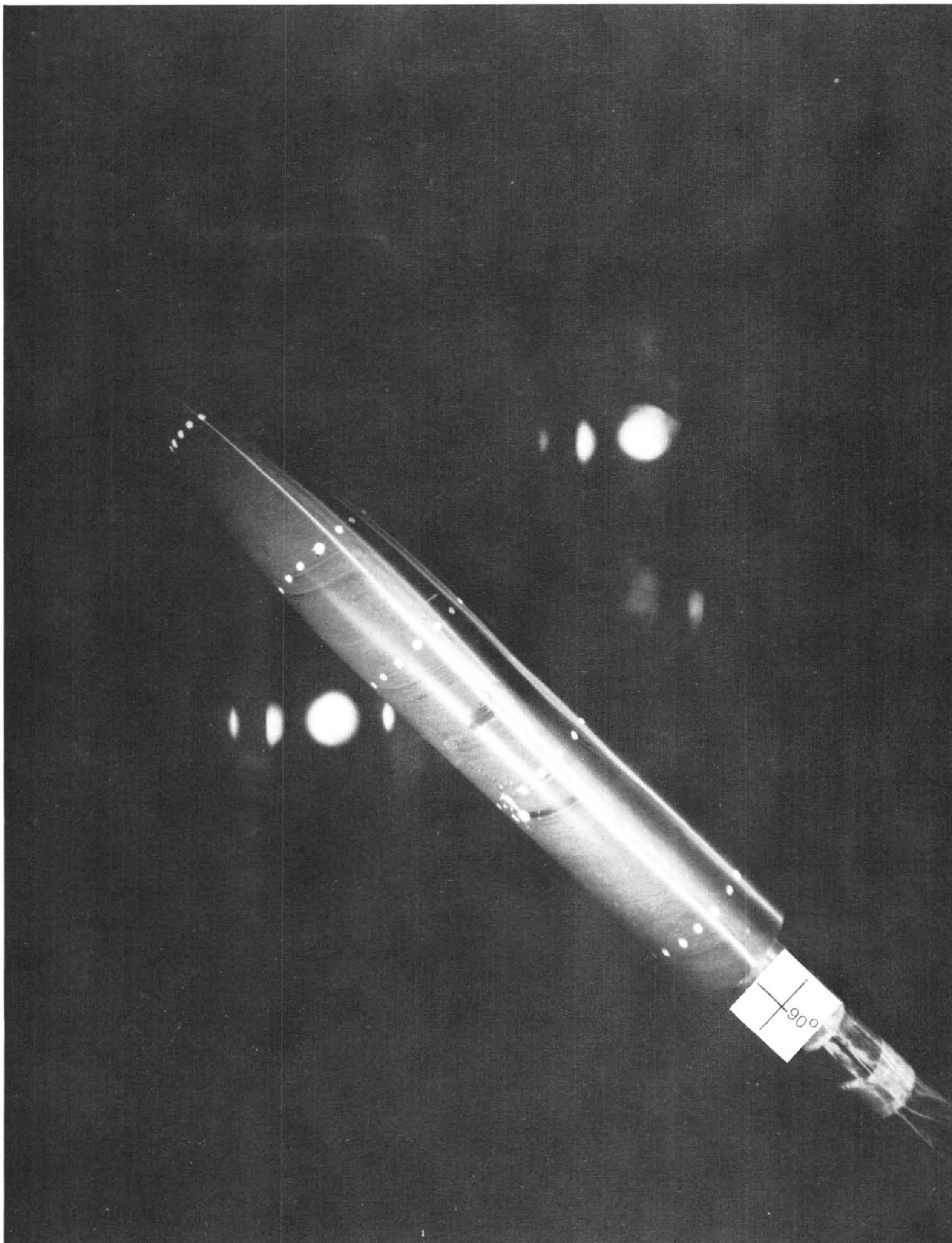
Figure 8.- Continued.



$\alpha = 36^{\circ}$

(a) Continued.

Figure 8.- Continued.



$\alpha = 44^{\circ}$

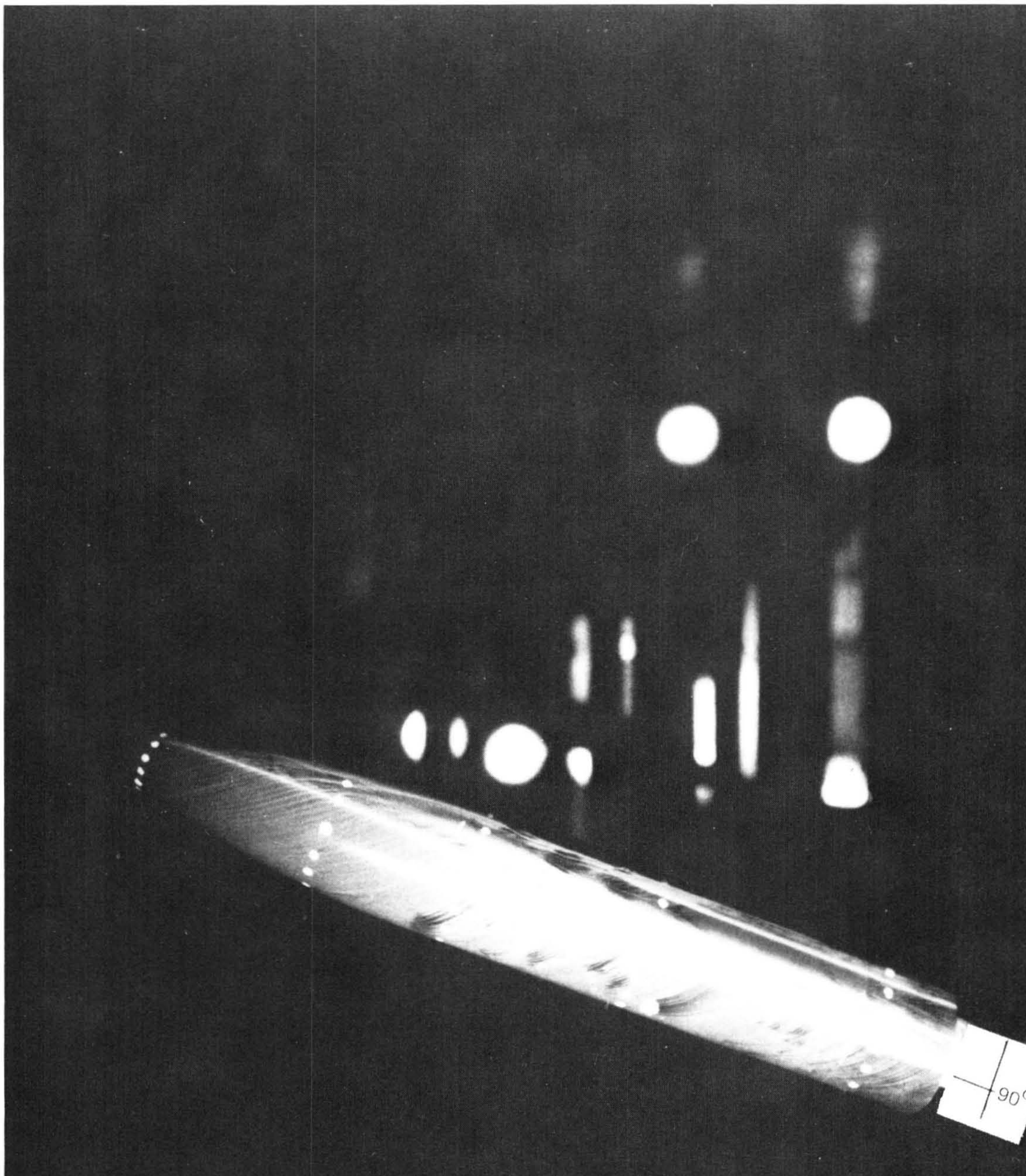
(a) Concluded.

Figure 8.- Continued.

$\alpha = 12^{\circ}$

(b) $M_{\infty} = 2.3$.

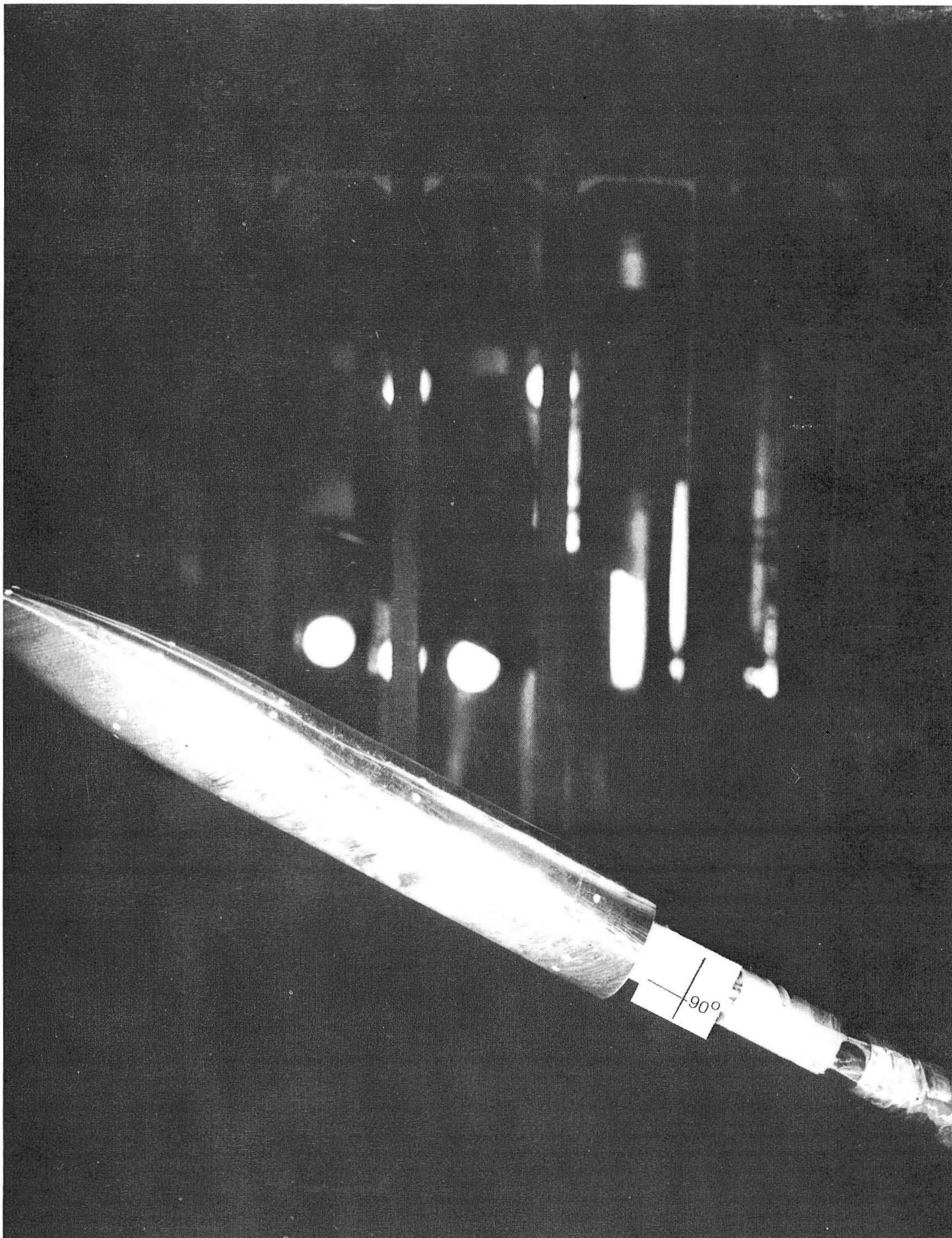
Figure 8.- Continued.



$\alpha = 20^{\circ}$

(b) Continued.

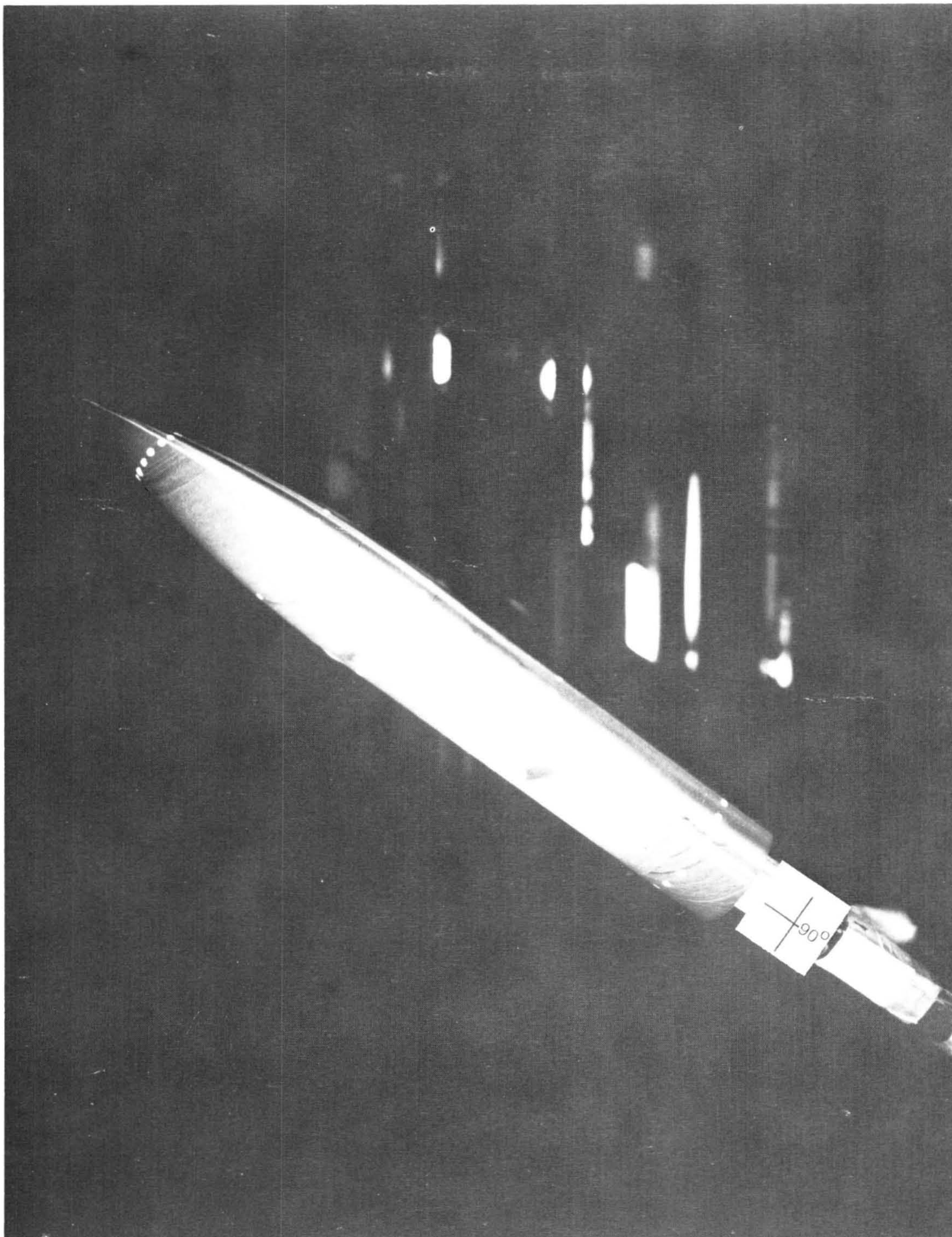
Figure 8.- Continued.



$\alpha = 28^{\circ}$

(b) Continued.

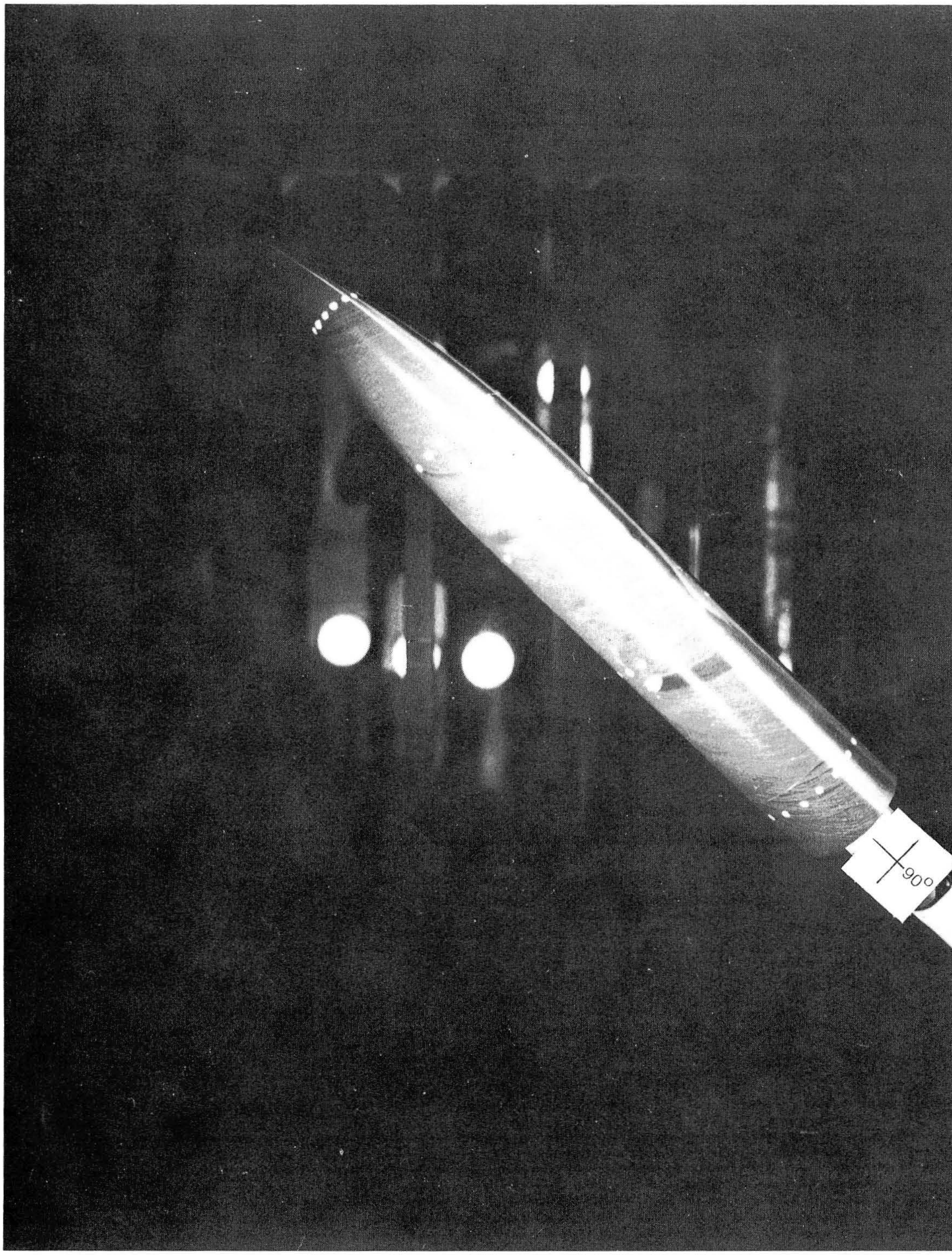
Figure 8.- Continued.



$\alpha = 36^{\circ}$

(b) Continued.

Figure 8.- Continued.



$\alpha = 44^{\circ}$

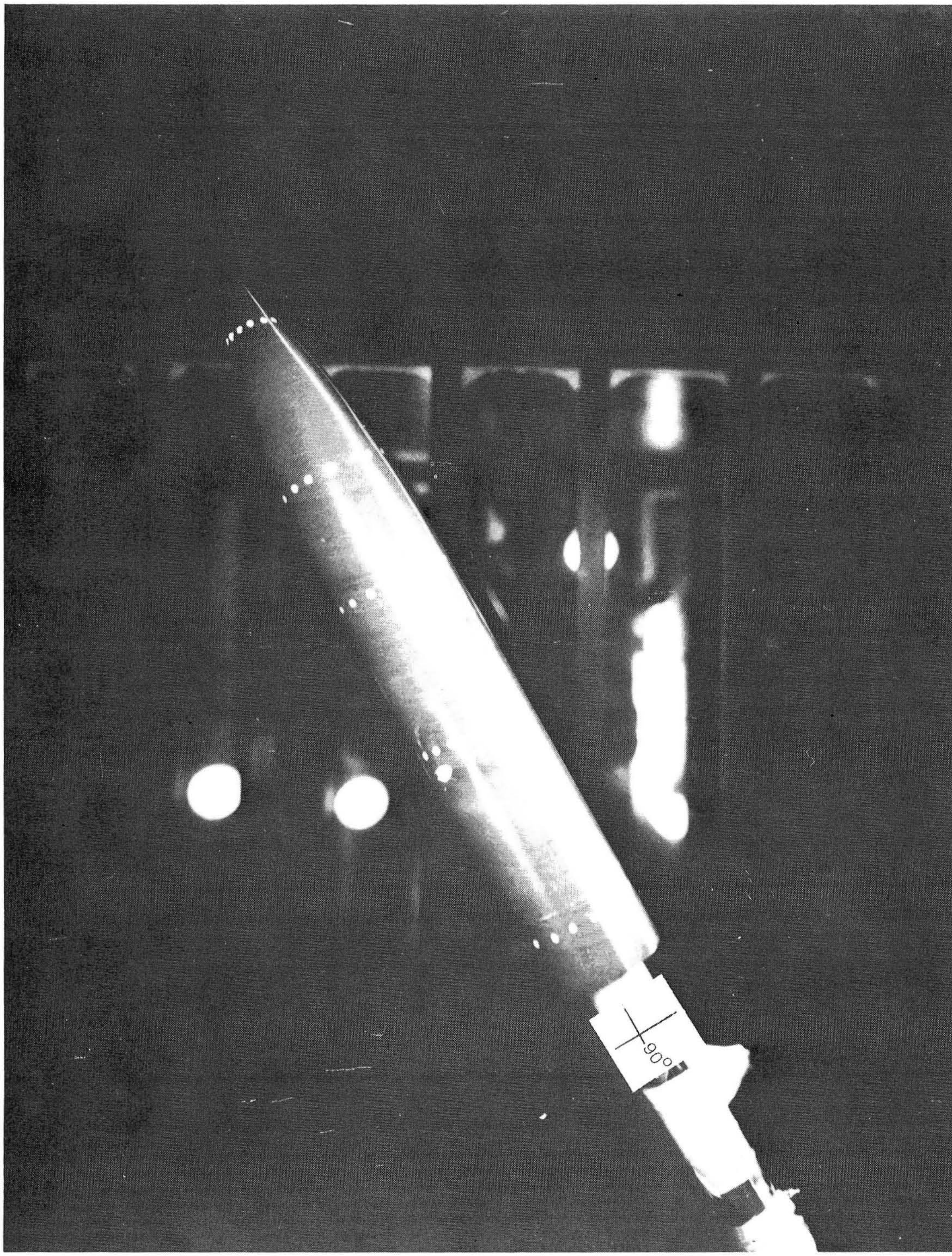
(b) Continued.

Figure 8.- Continued.

$\alpha = 52^{\circ}$

(b) Continued.

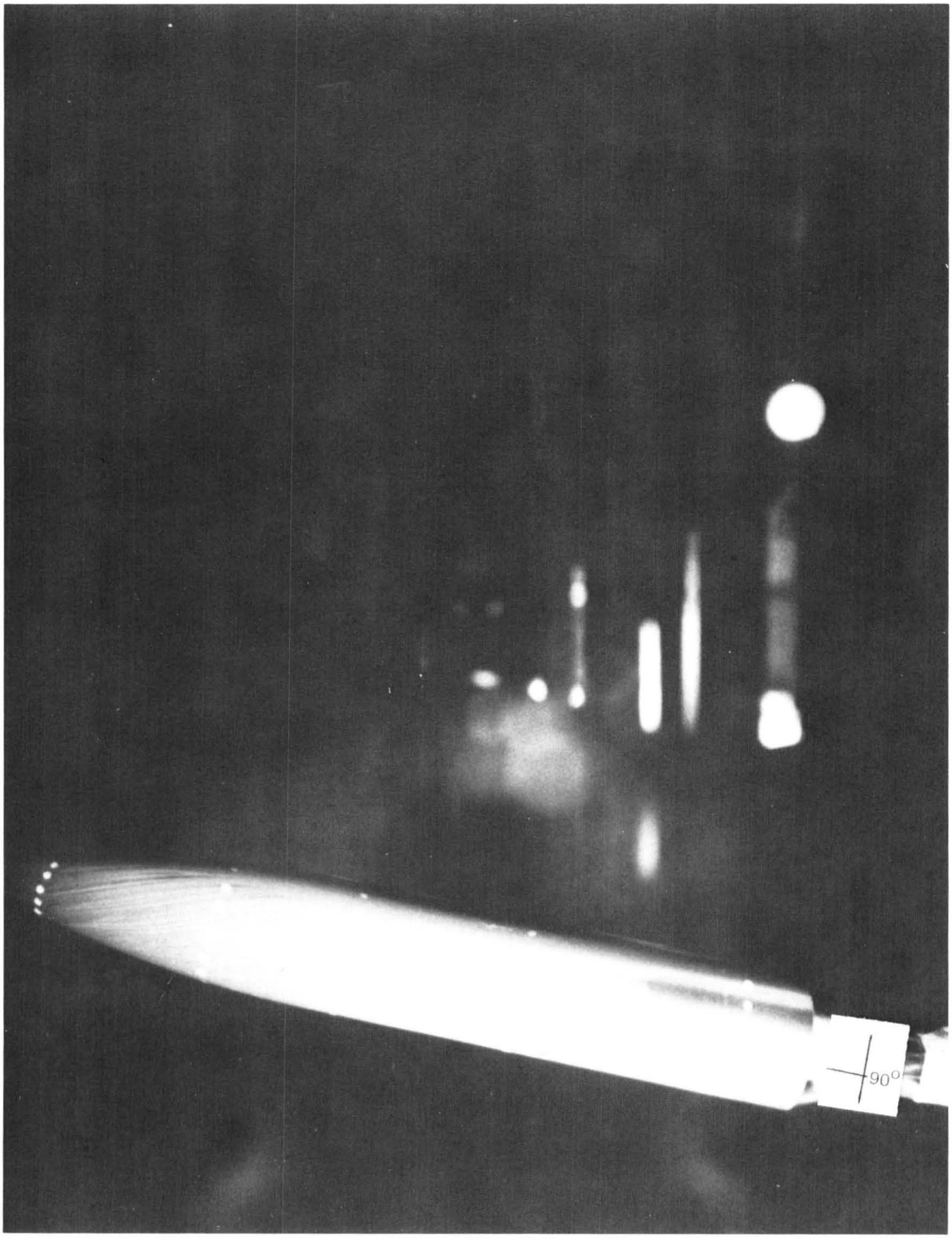
Figure 8.- Continued.



$\alpha = 60^{\circ}$

(b) Concluded.

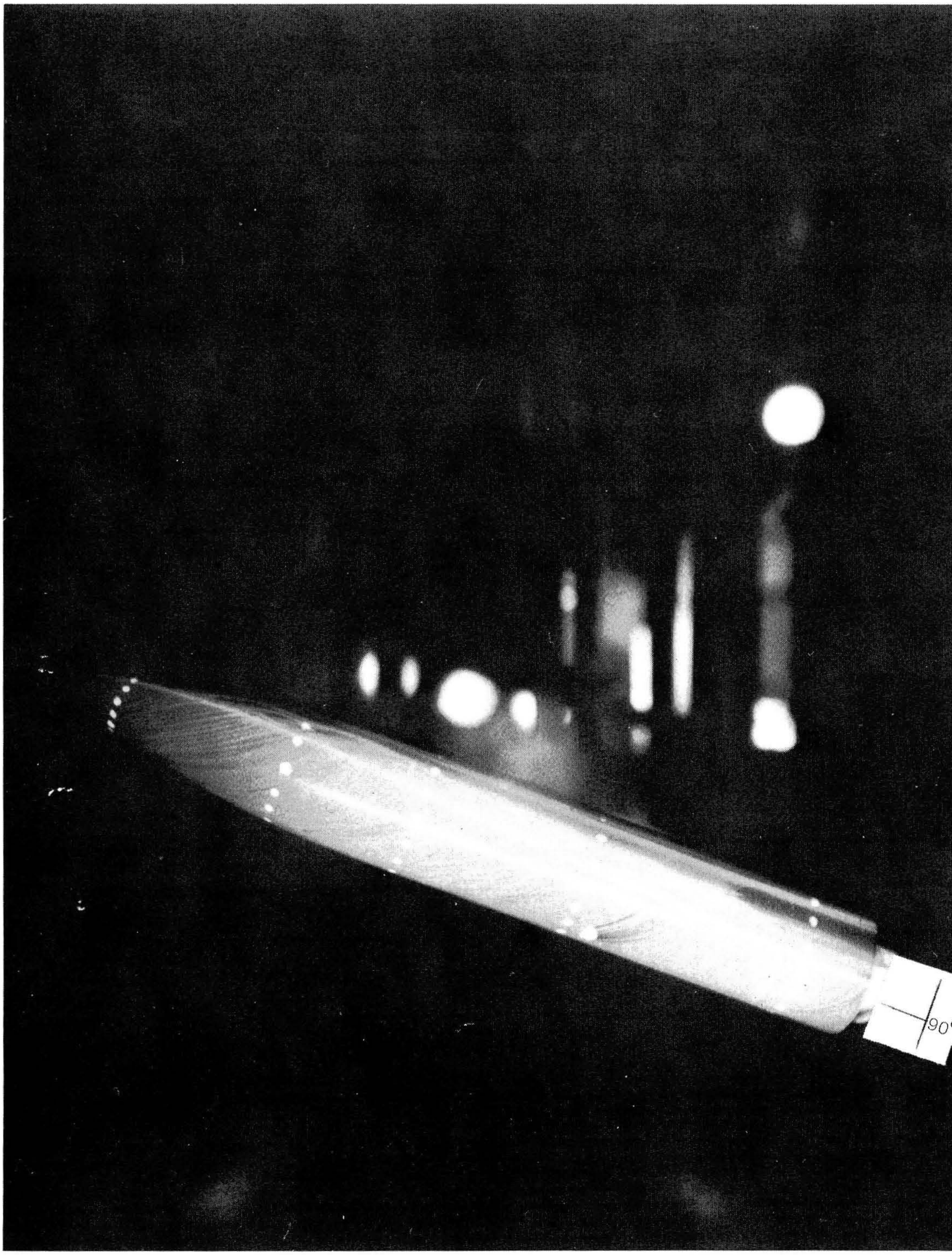
Figure 8.- Continued.



$\alpha = 12^{\circ}$

(c) $M_{\infty} = 2.96$.

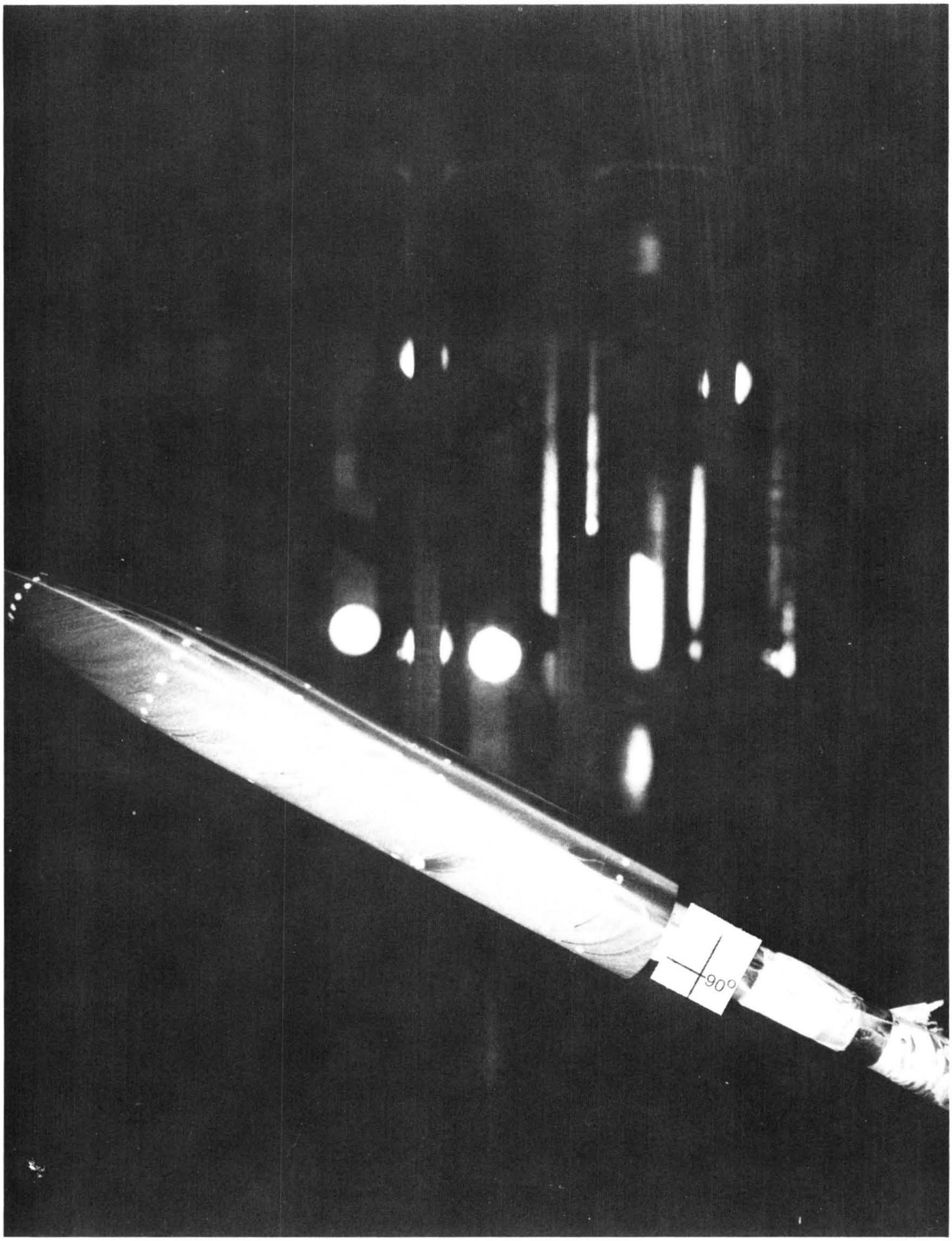
Figure 8.- Continued.



$\alpha = 20^{\circ}$

(c) Continued.

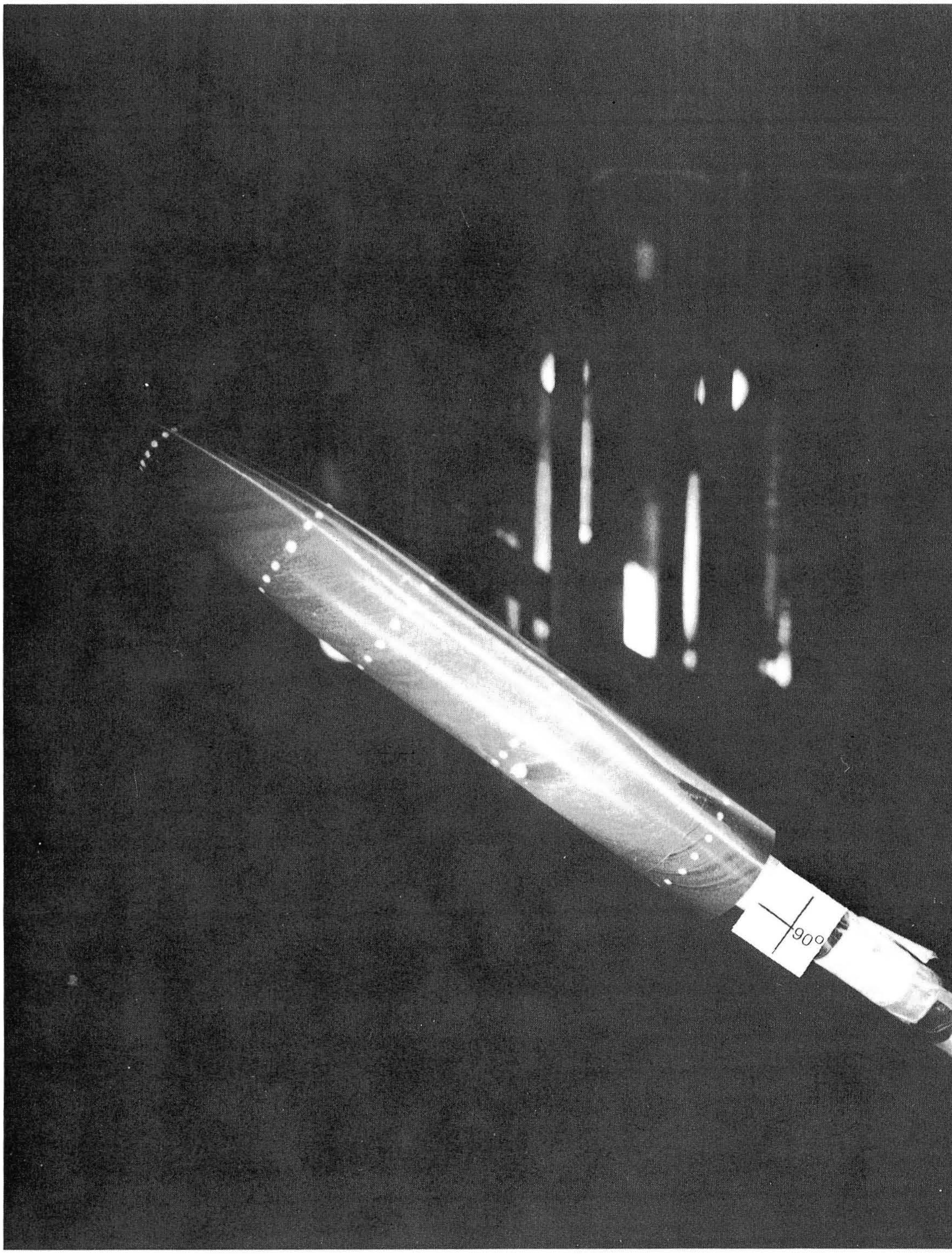
Figure 8.- Continued.



$\alpha = 28^{\circ}$

(c) Continued.

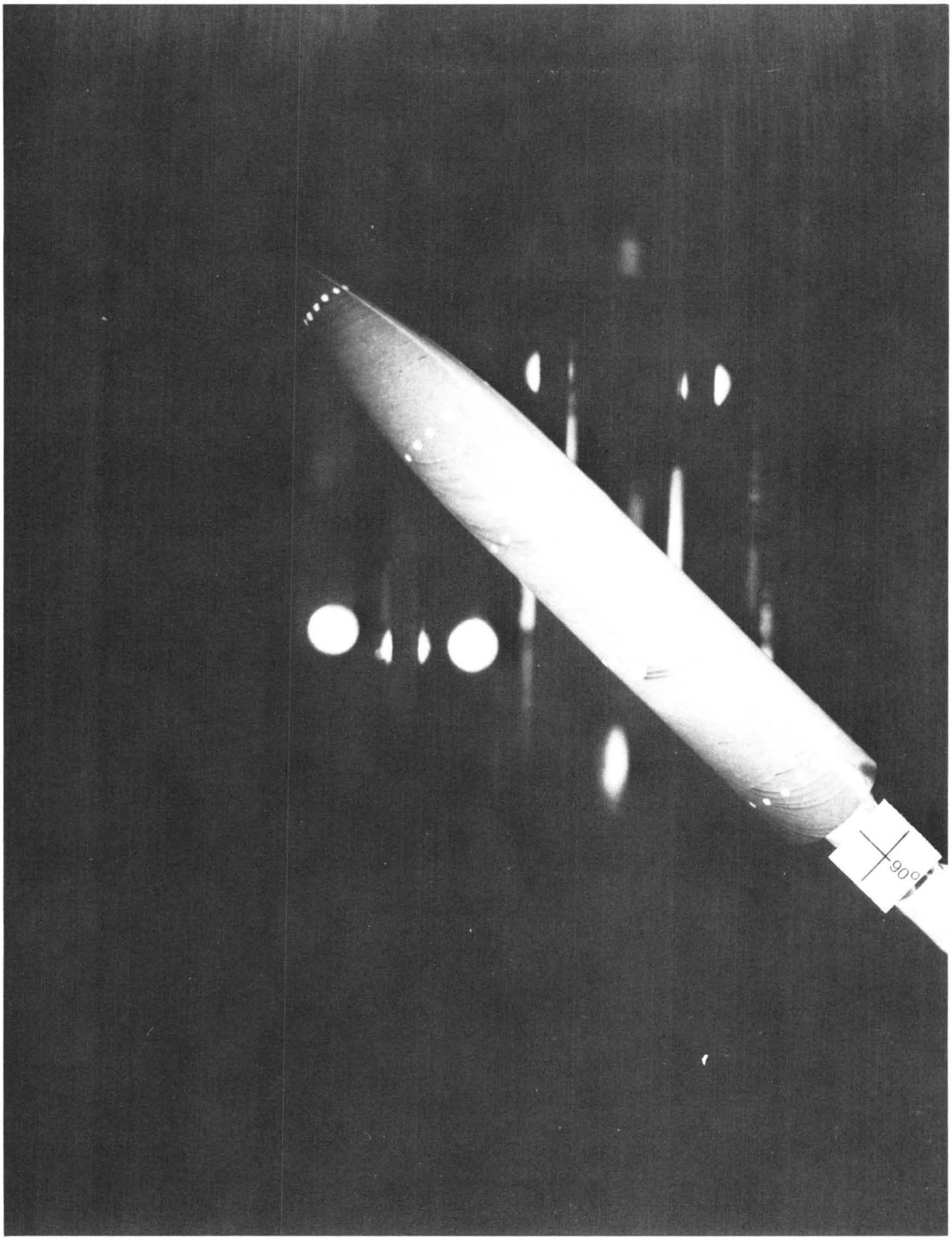
Figure 8.- Continued.



$\alpha = 36^{\circ}$

(c) Continued.

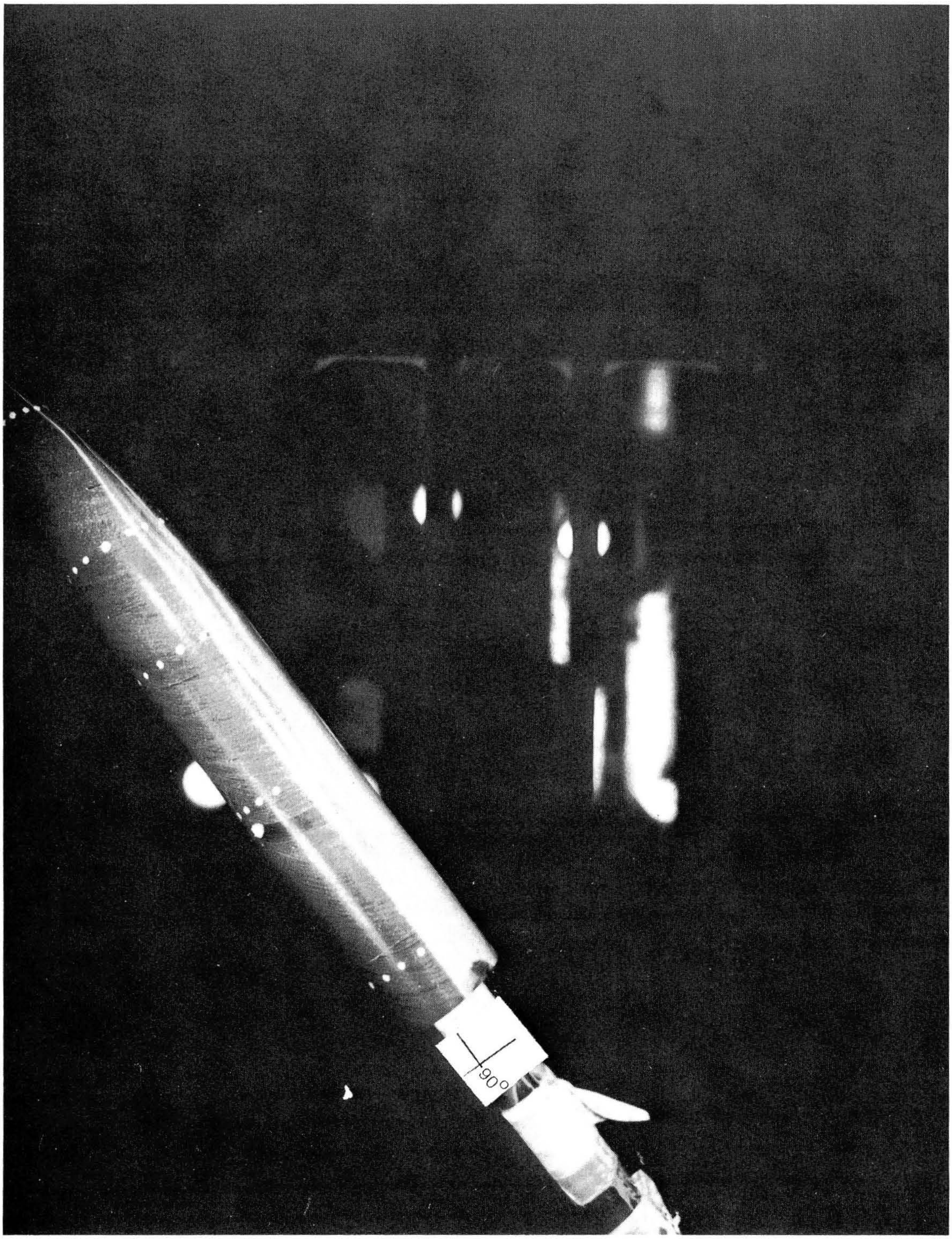
Figure 8.- Continued.



$\alpha = 44^{\circ}$

(c) Continued.

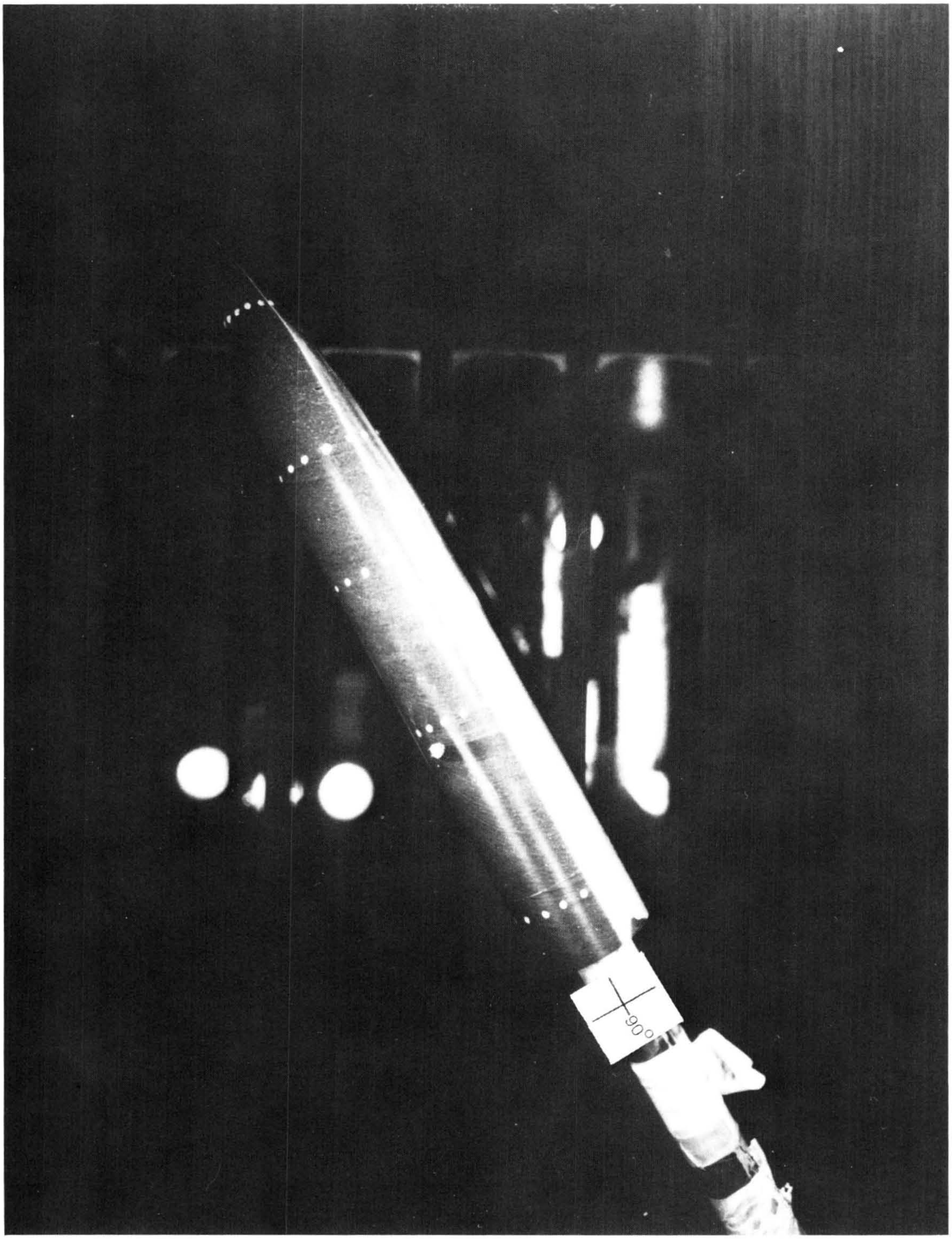
Figure 8.- Continued.



$\alpha = 52^{\circ}$

(c) Continued.

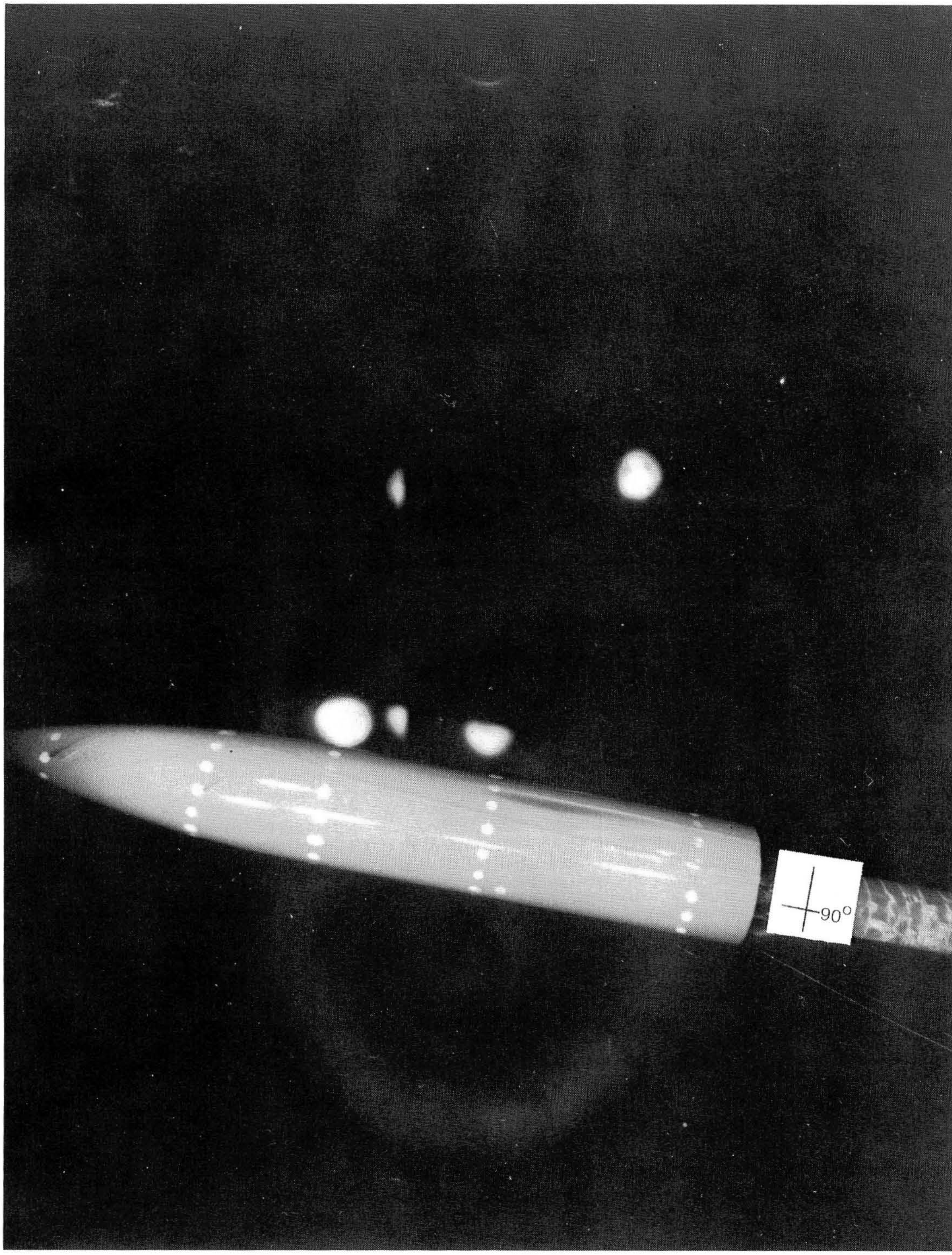
Figure 8.- Continued.



$\alpha = 60^{\circ}$

(c) Concluded.

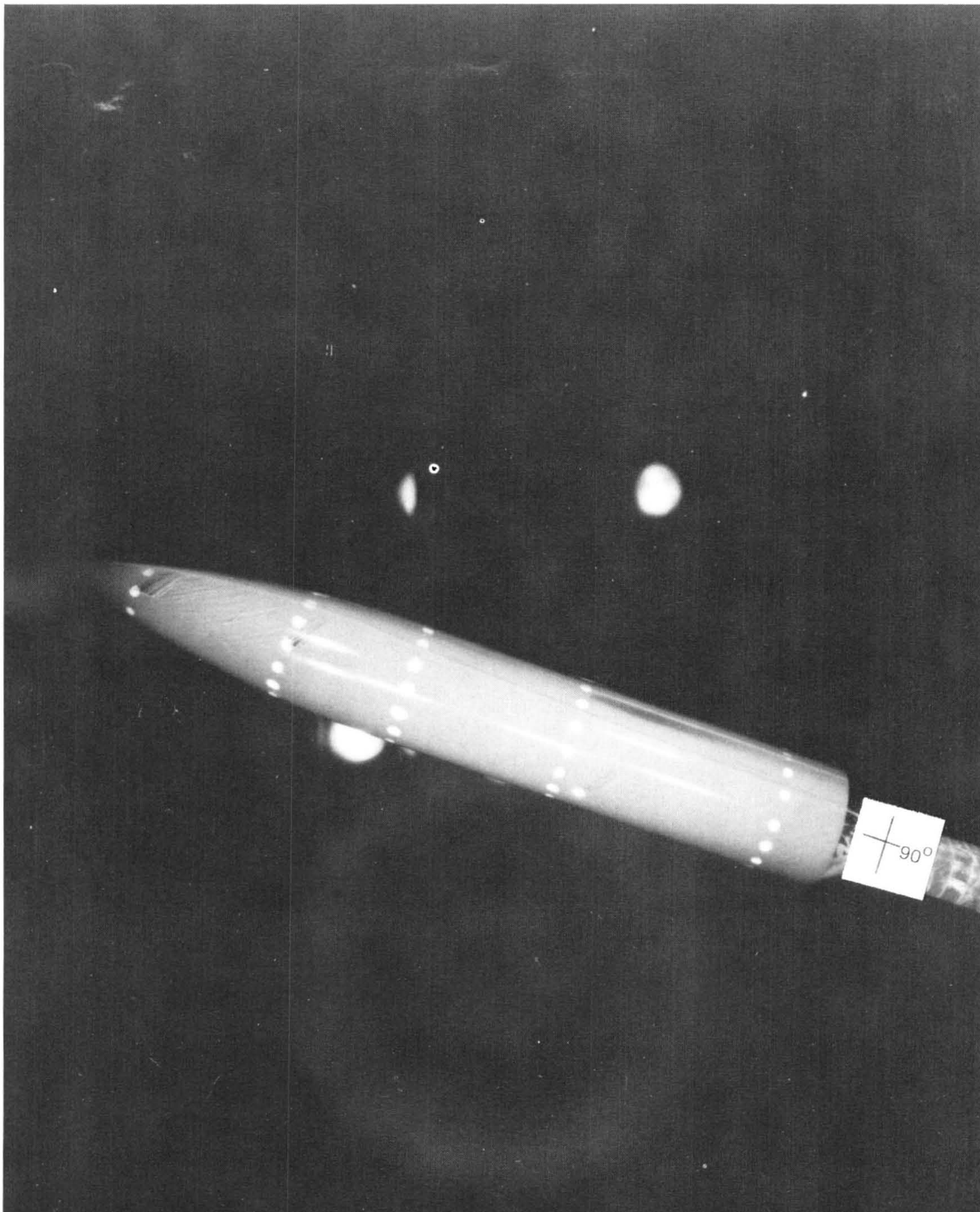
Figure 8.- Continued.



$\alpha = 12^{\circ}$

(d) $M_{\infty} = 4.63$.

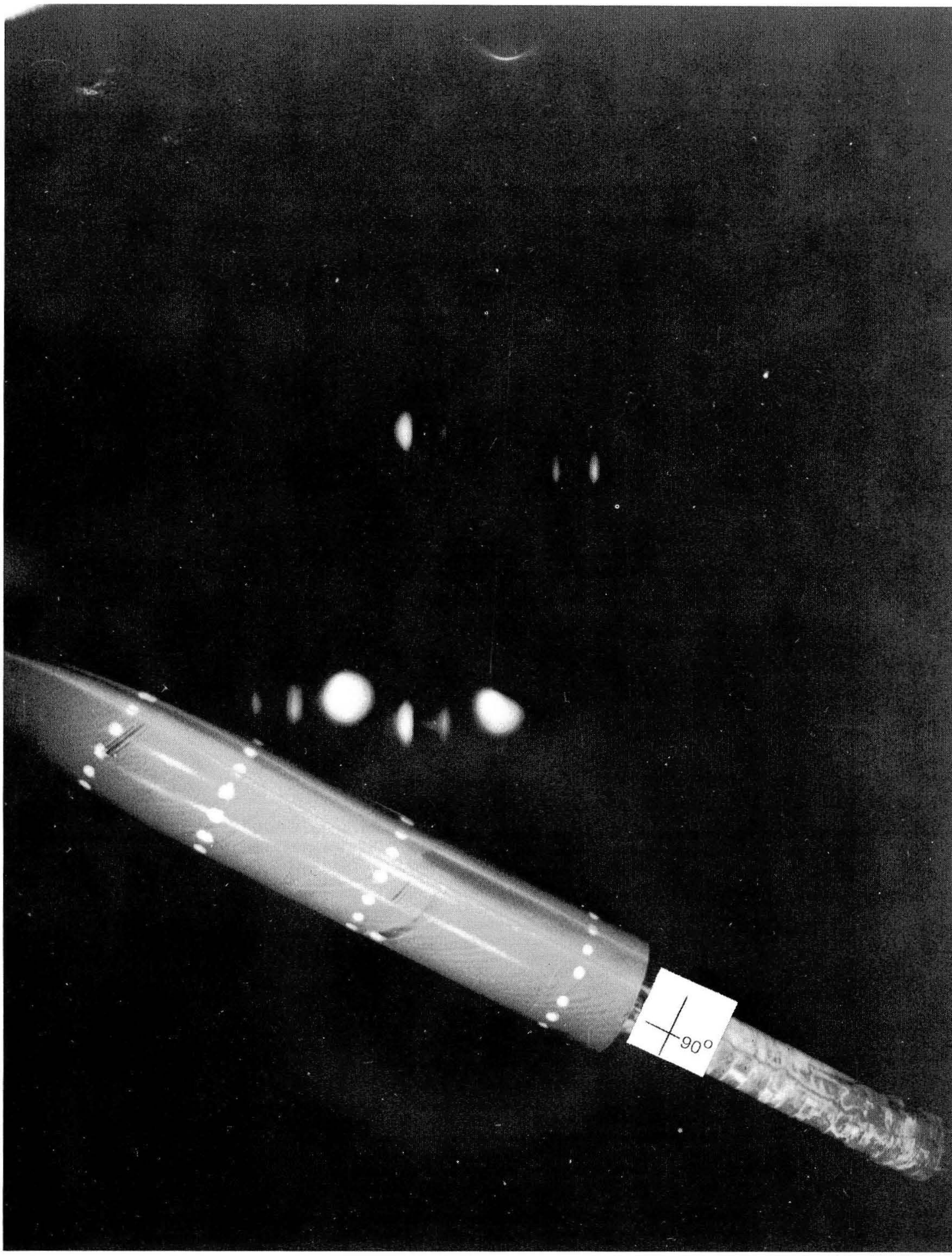
Figure 8.- Continued.



$\alpha = 20^{\circ}$

(d) Continued.

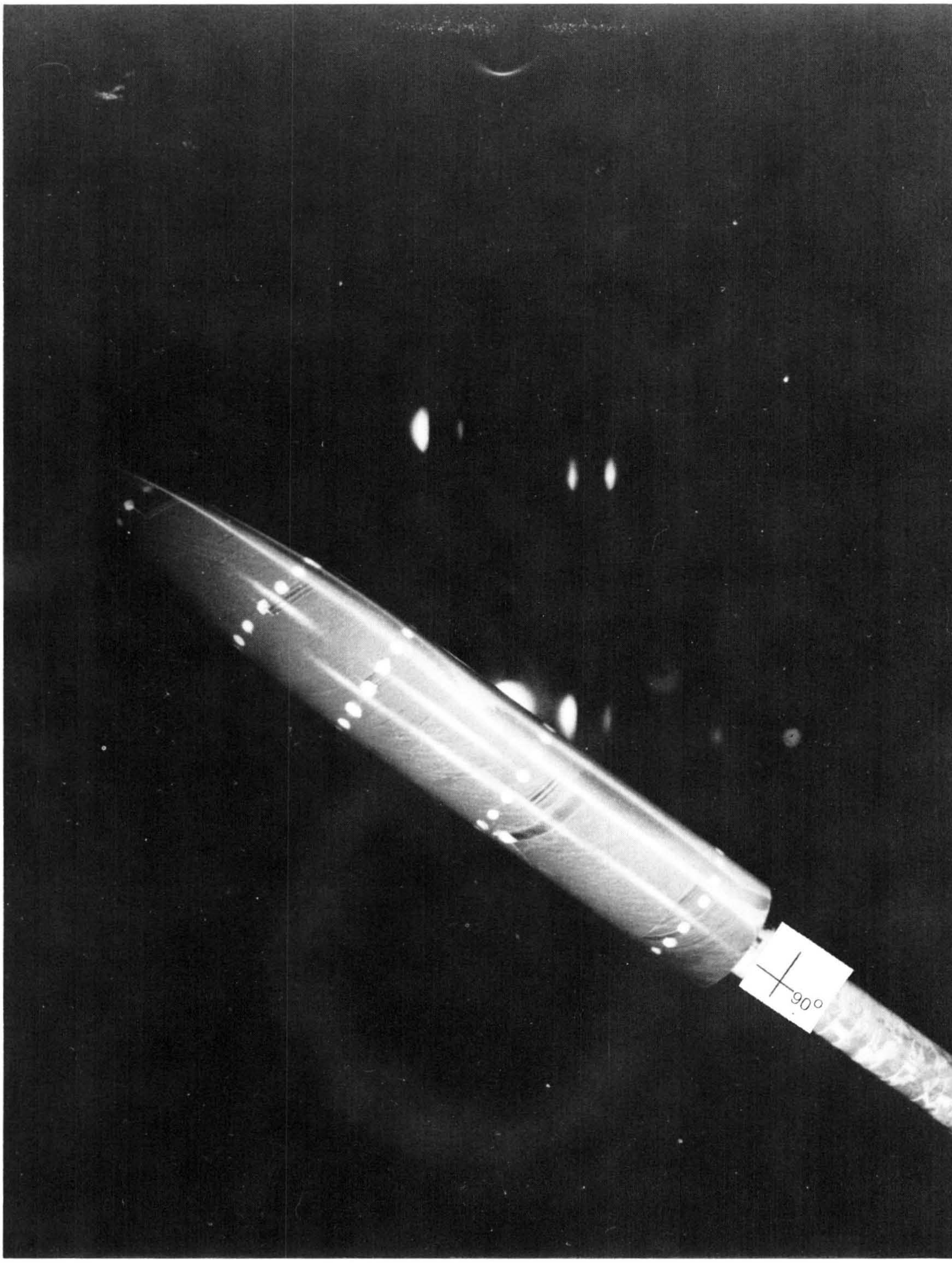
Figure 8.- Continued.



$\alpha = 28^{\circ}$

(d) Continued.

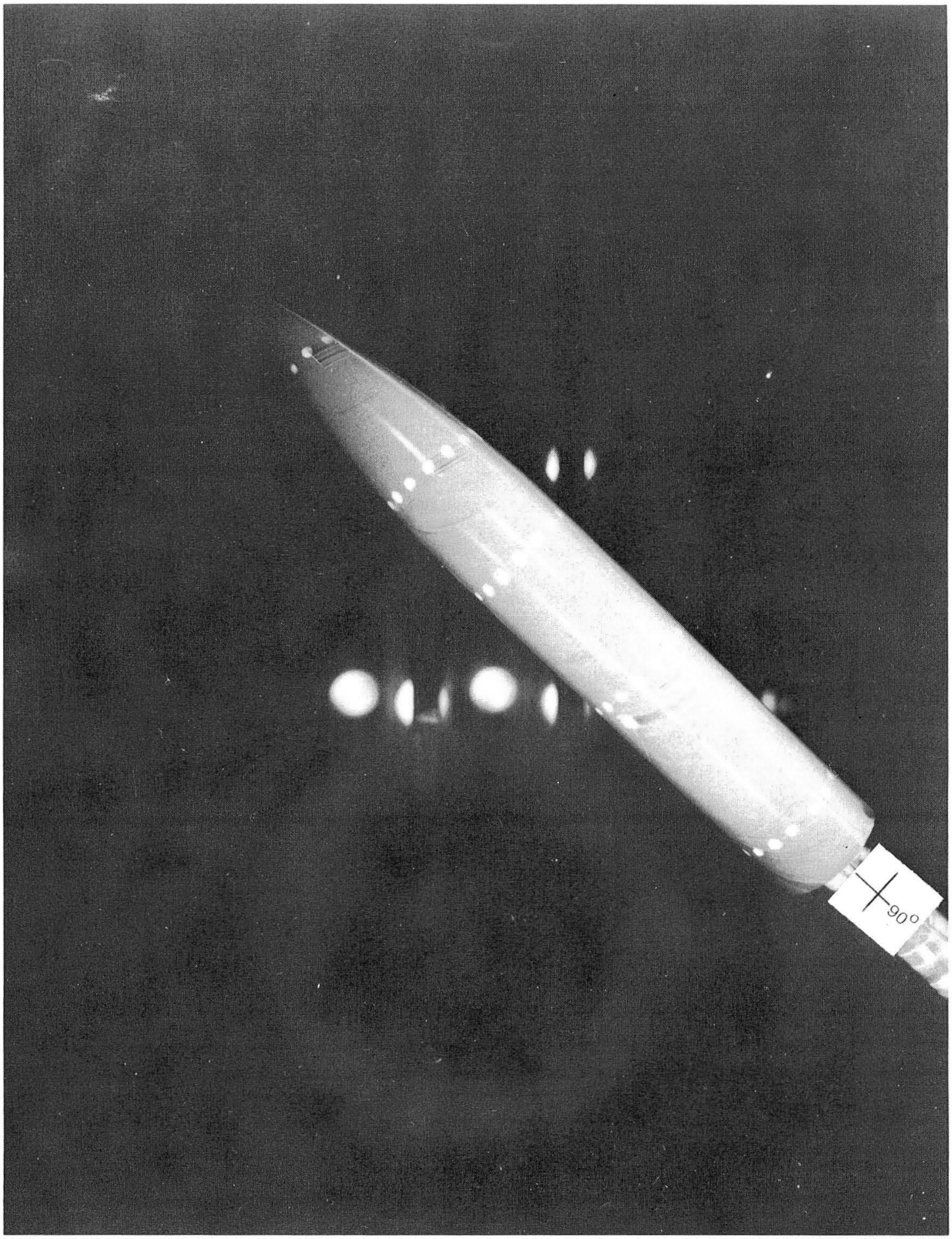
Figure 8.- Continued.



α = 36°

(d) Continued.

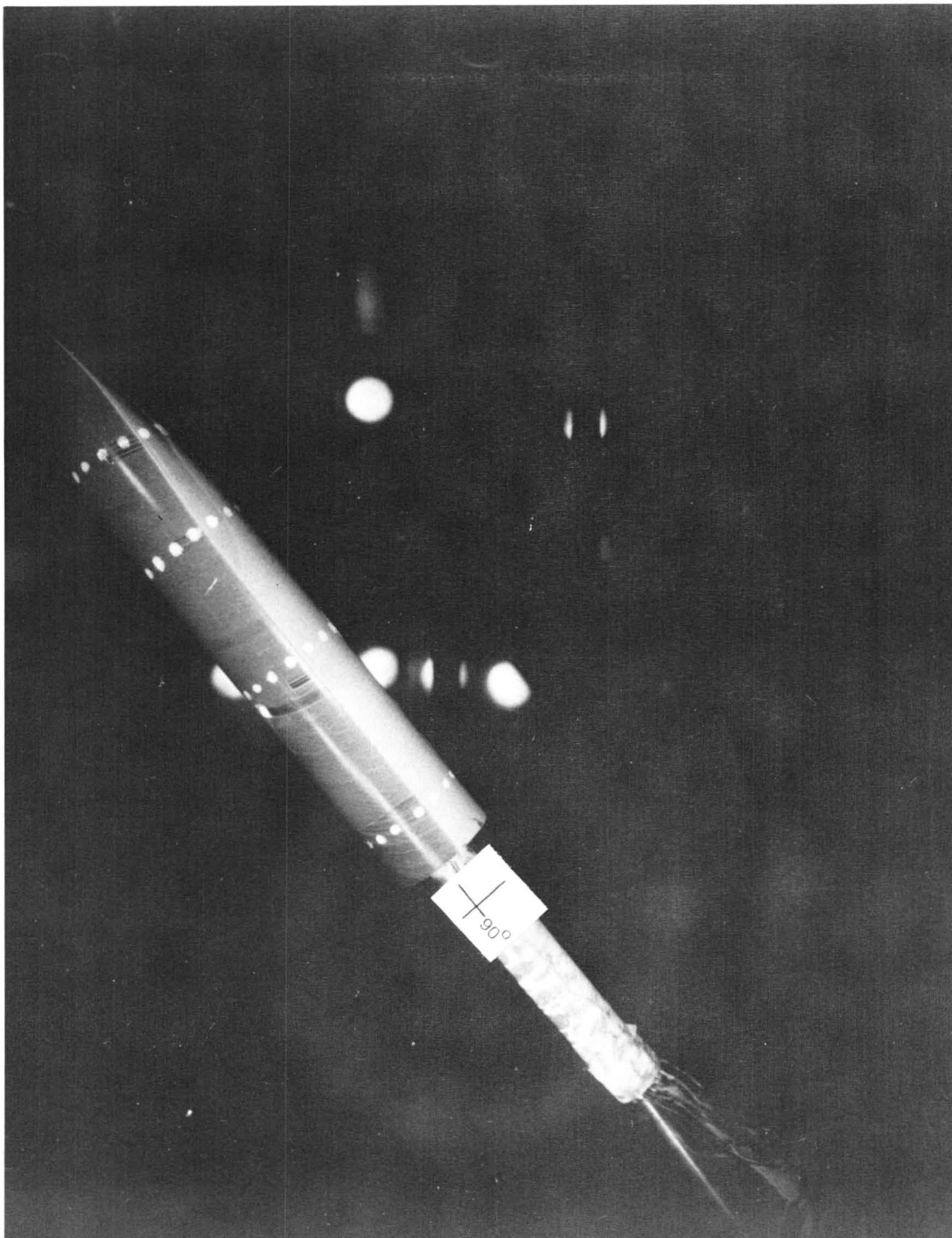
Figure 8.- Continued.



$\alpha = 44^{\circ}$

(d) Continued.

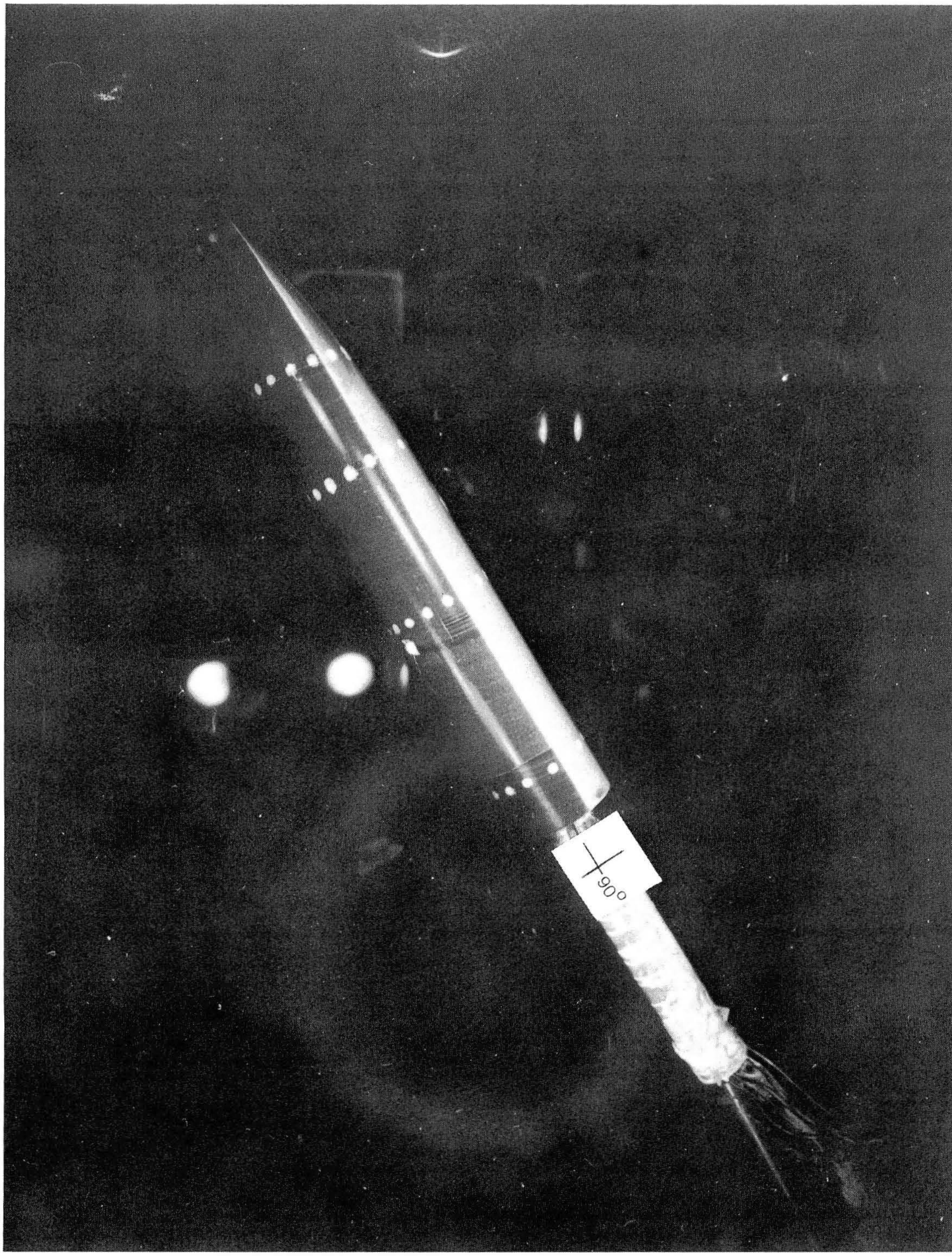
Figure 8.- Continued.



$\alpha = 52^{\circ}$

(d) Continued.

Figure 8.- Continued.



$\alpha = 60^{\circ}$

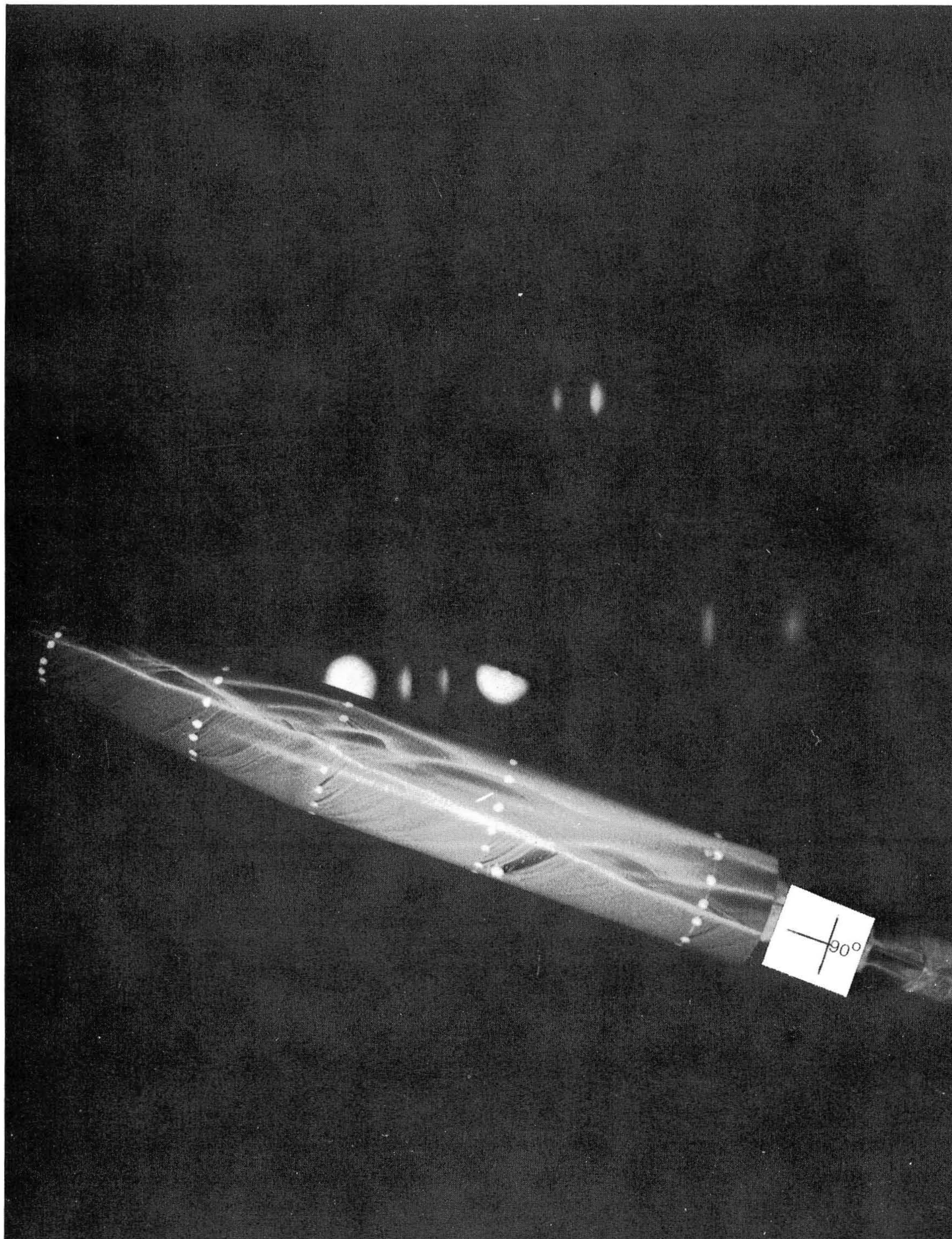
(d) Concluded.

Figure 8.- Concluded.

$\alpha = 12^{\circ}$

(a) $M_{\infty} = 1.6$.

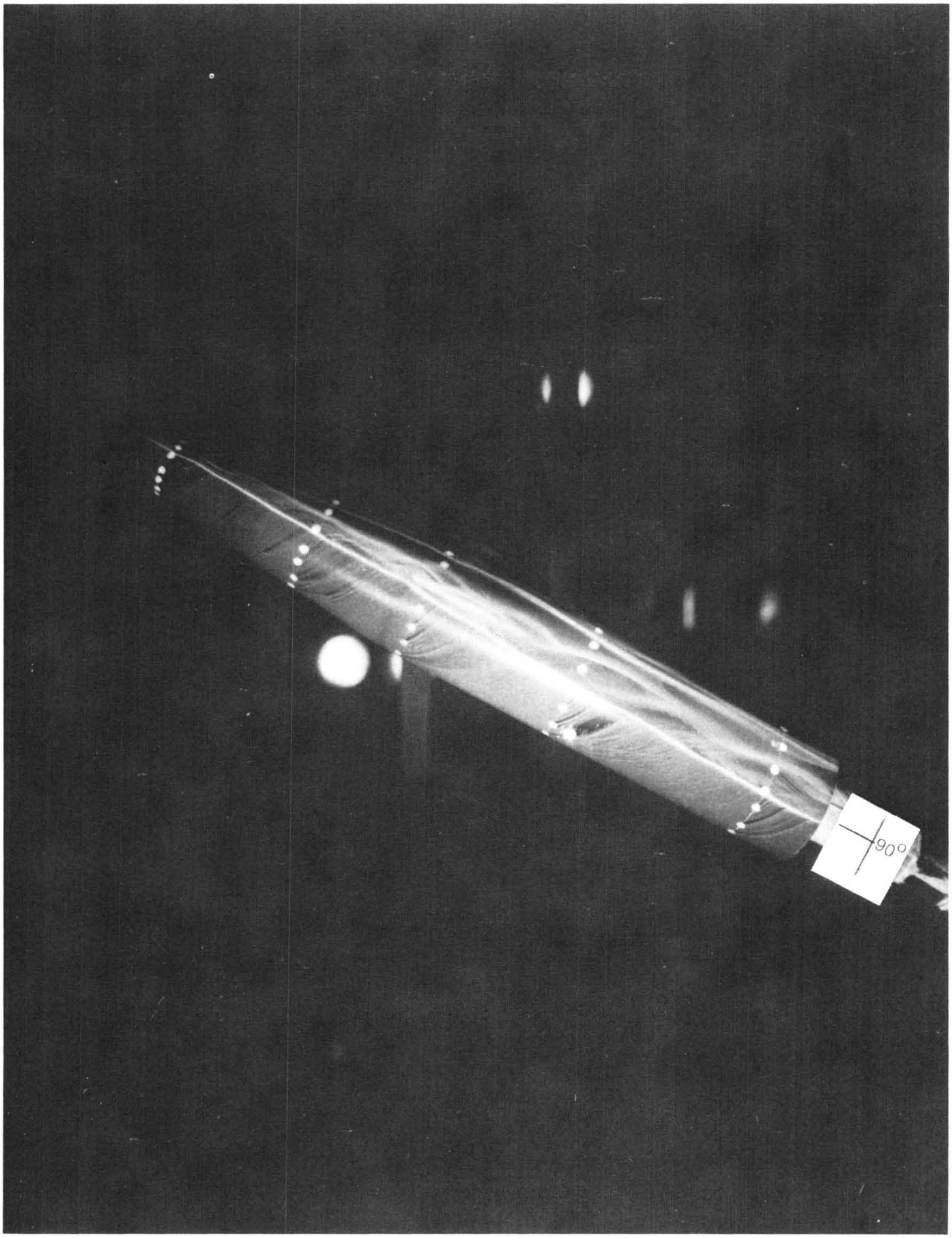
Figure 9.- Oil-flow photographs for blunt-nose—cylinder model.



$\alpha = 20^{\circ}$

(a) Continued.

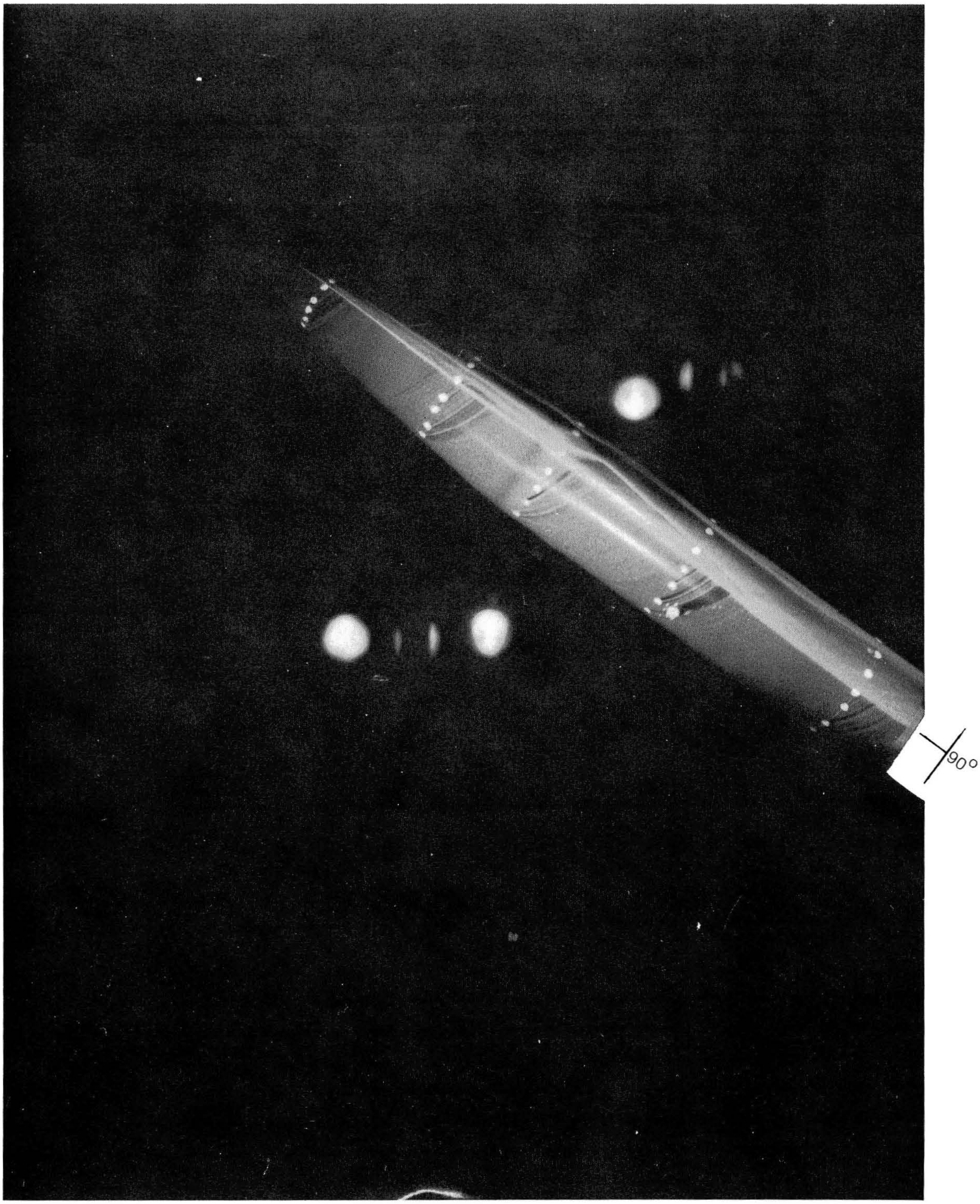
Figure 9.- Continued.



$\alpha = 28^{\circ}$

(a) Continued.

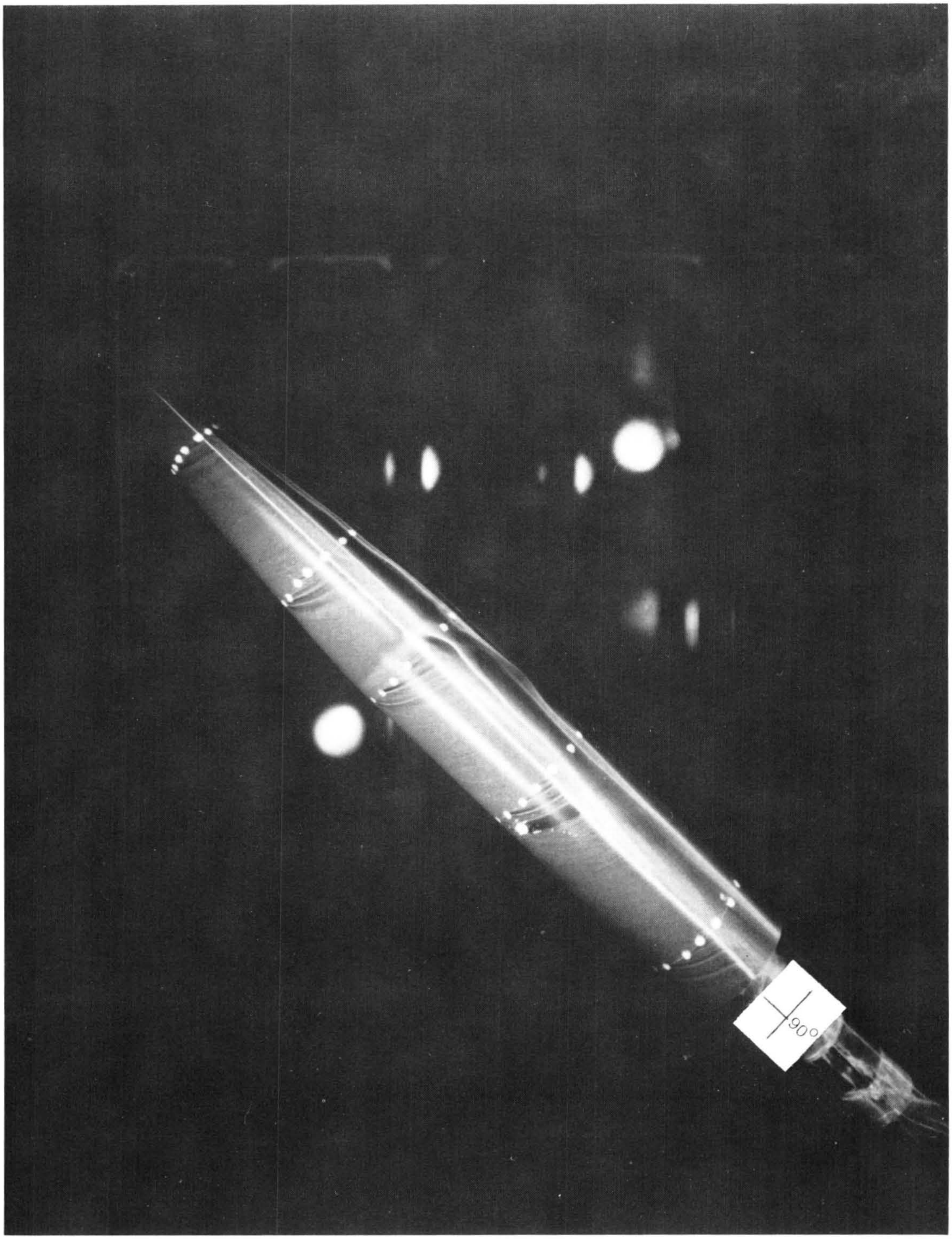
Figure 9.- Continued.



$\alpha = 36^{\circ}$

(a) Continued.

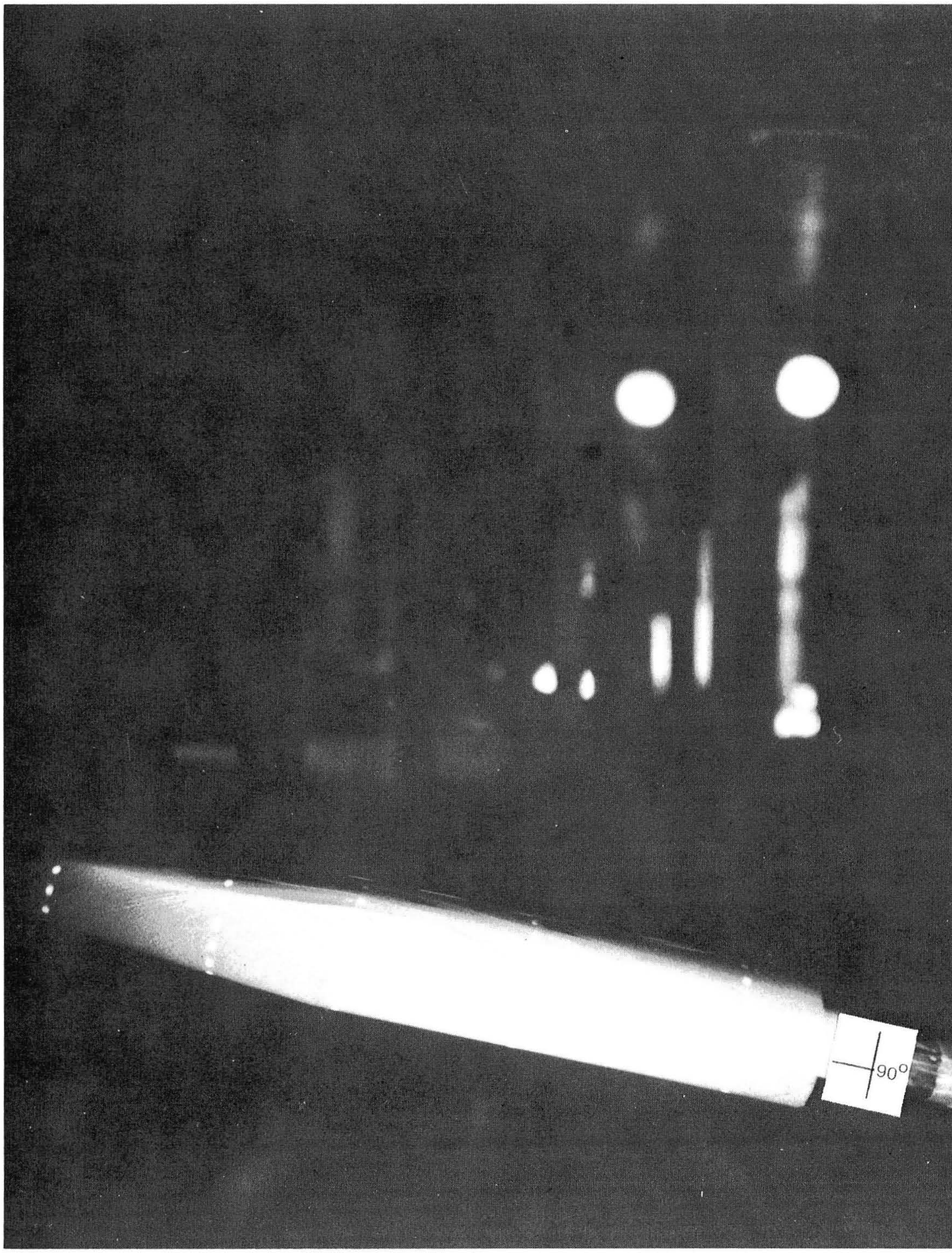
Figure 9.- Continued.



$\alpha = 44^{\circ}$

(a) Concluded.

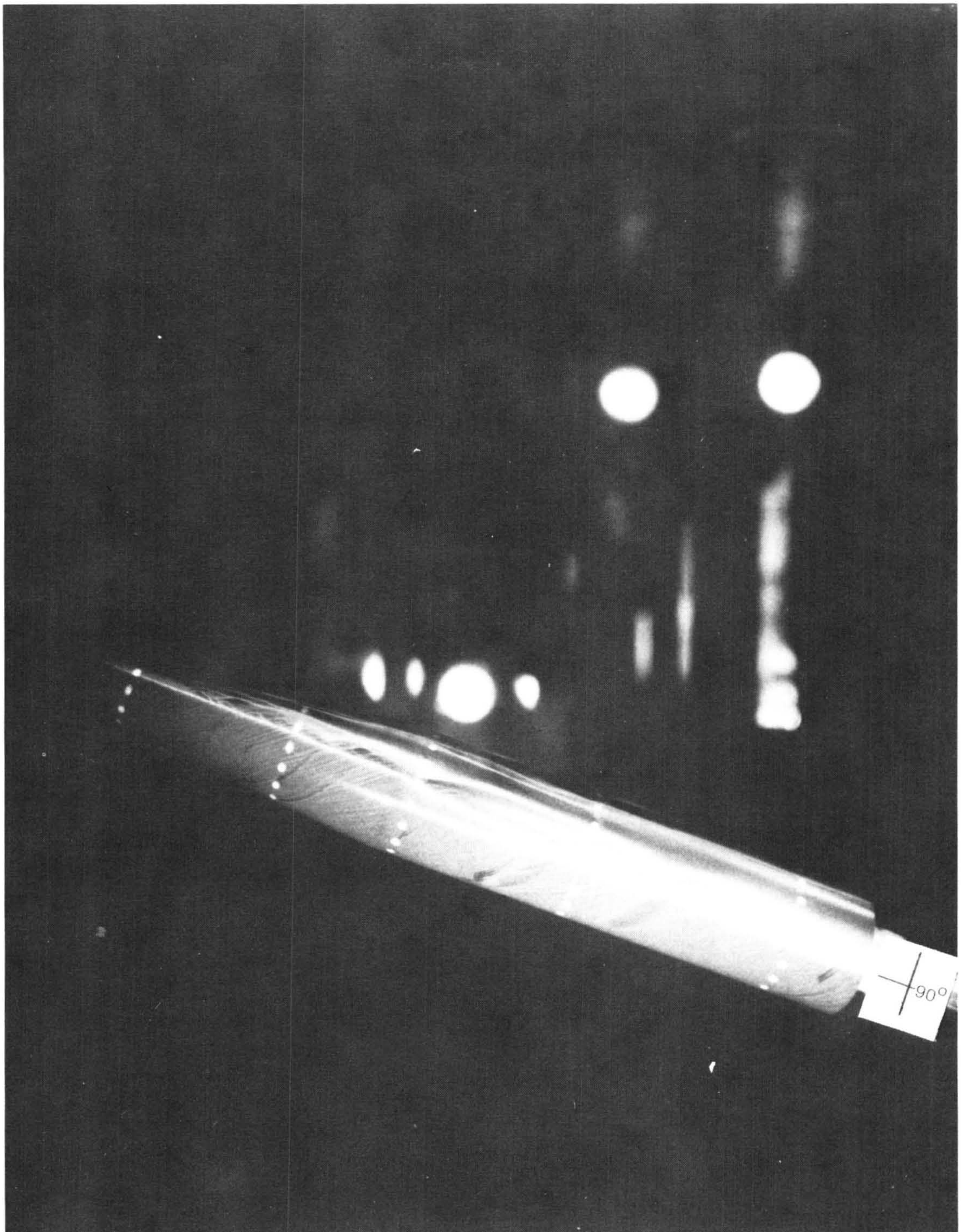
Figure 9.- Continued.



$\alpha = 12^{\circ}$

(b) $M_{\infty} = 2.3$.

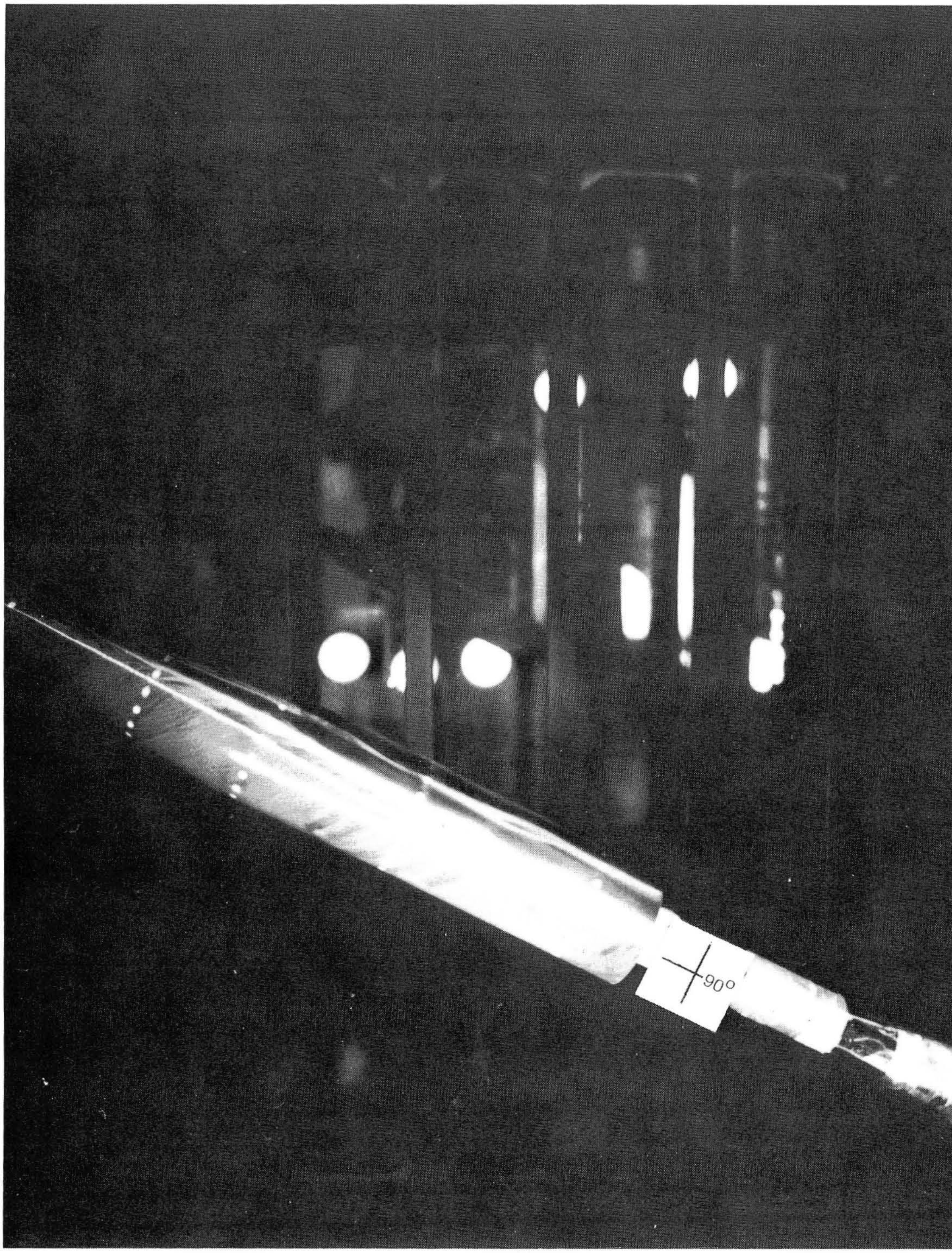
Figure 9.- Continued.



$\alpha = 20^\circ$

(b) Continued.

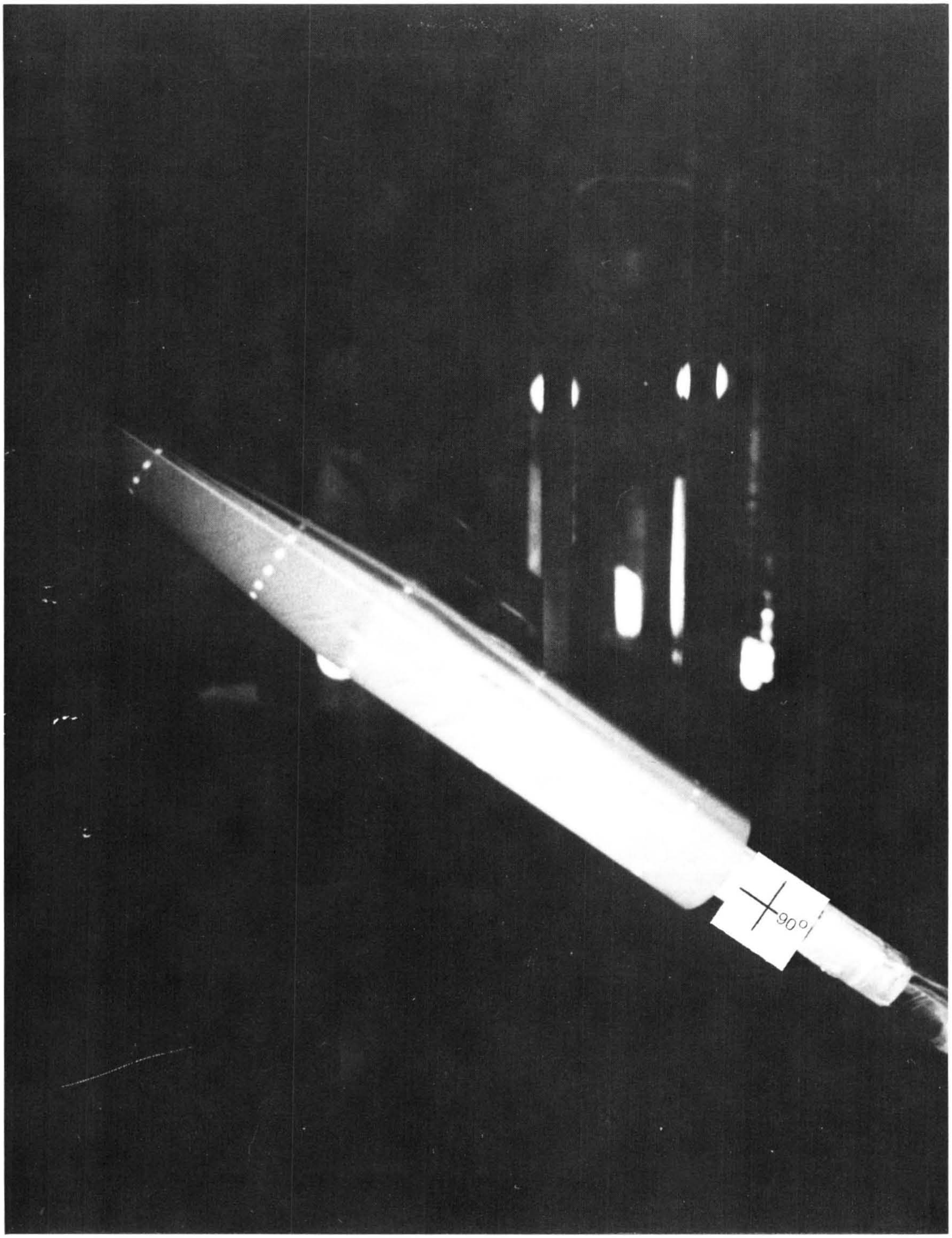
Figure 9.- Continued.



$\alpha = 28°$

(b) Continued.

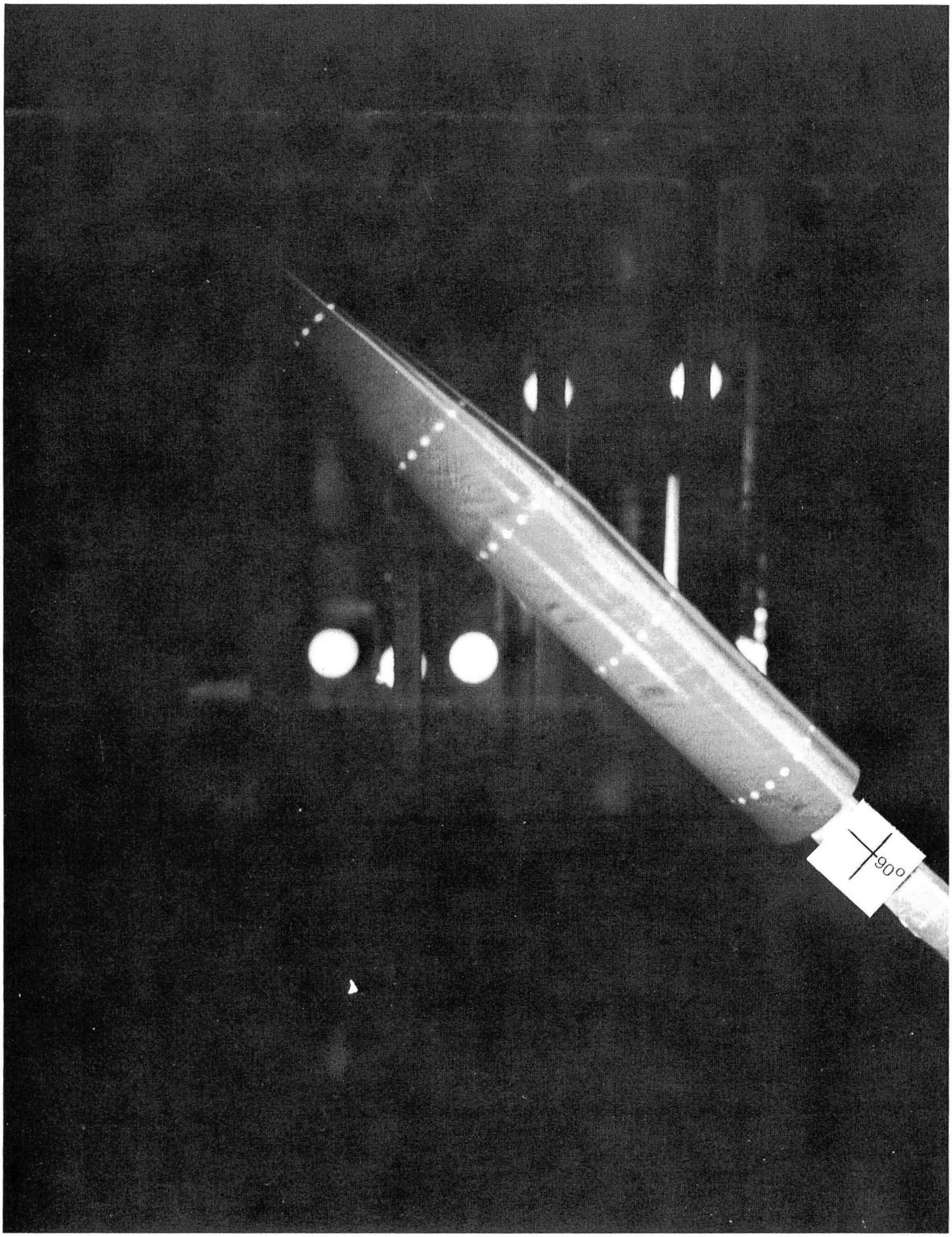
Figure 9.- Continued.



$\alpha = 36^{\circ}$

(b) Continued.

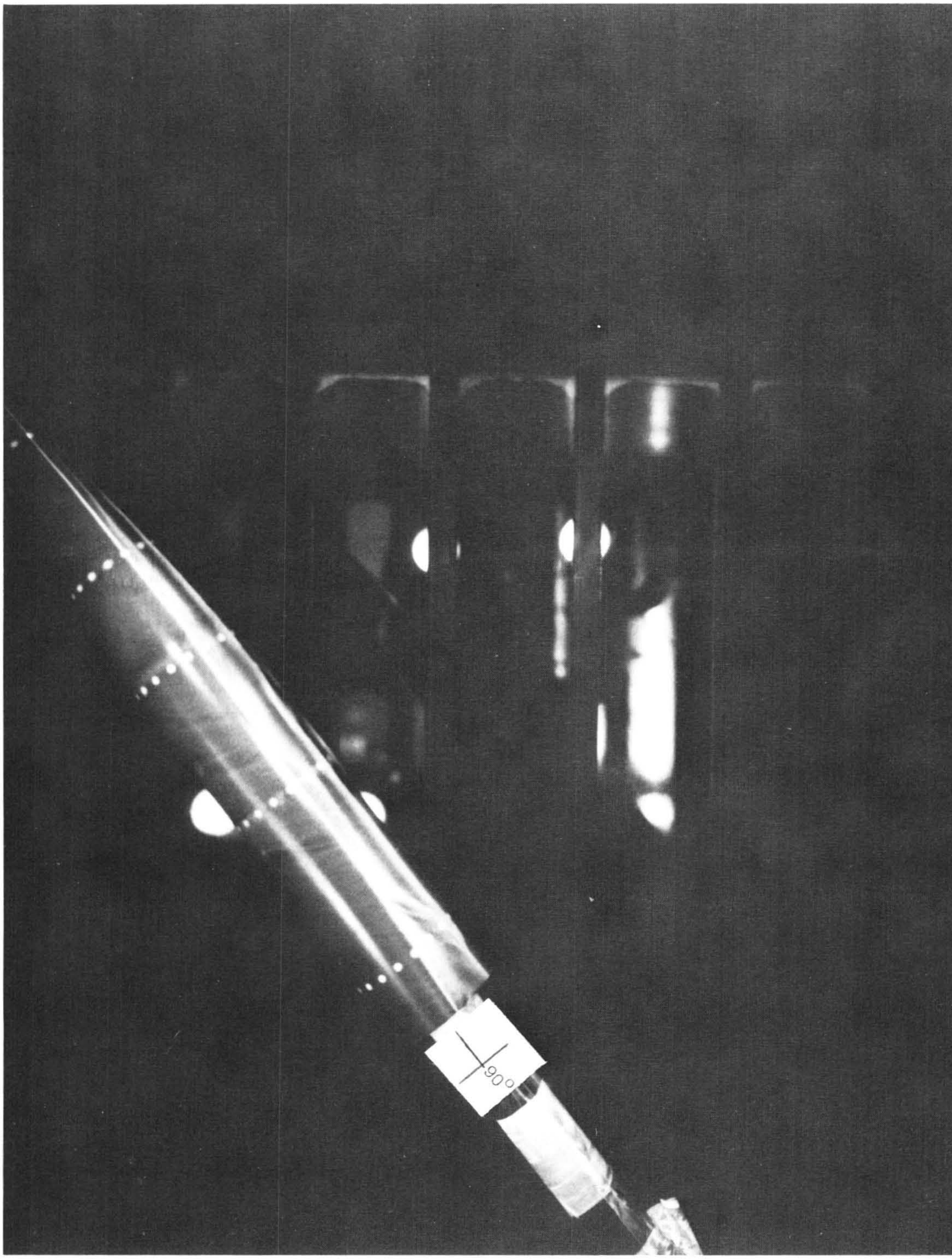
Figure 9.- Continued.



$\alpha = 44^{\circ}$

(b) Continued.

Figure 9.- Continued.



$\alpha = 52^{\circ}$

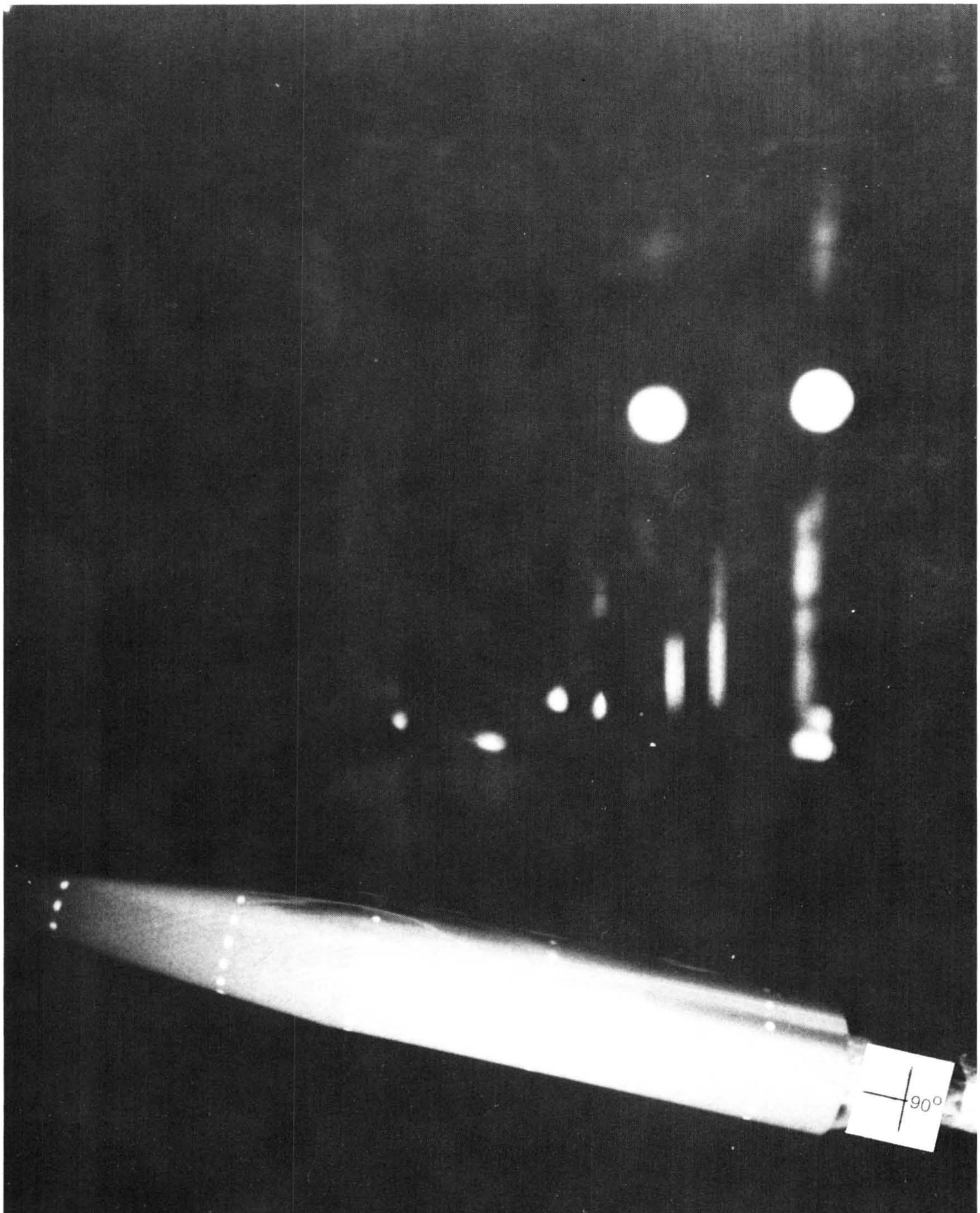
(b) Continued.

Figure 9.- Continued.

$\alpha = 60°$

(b) Concluded.

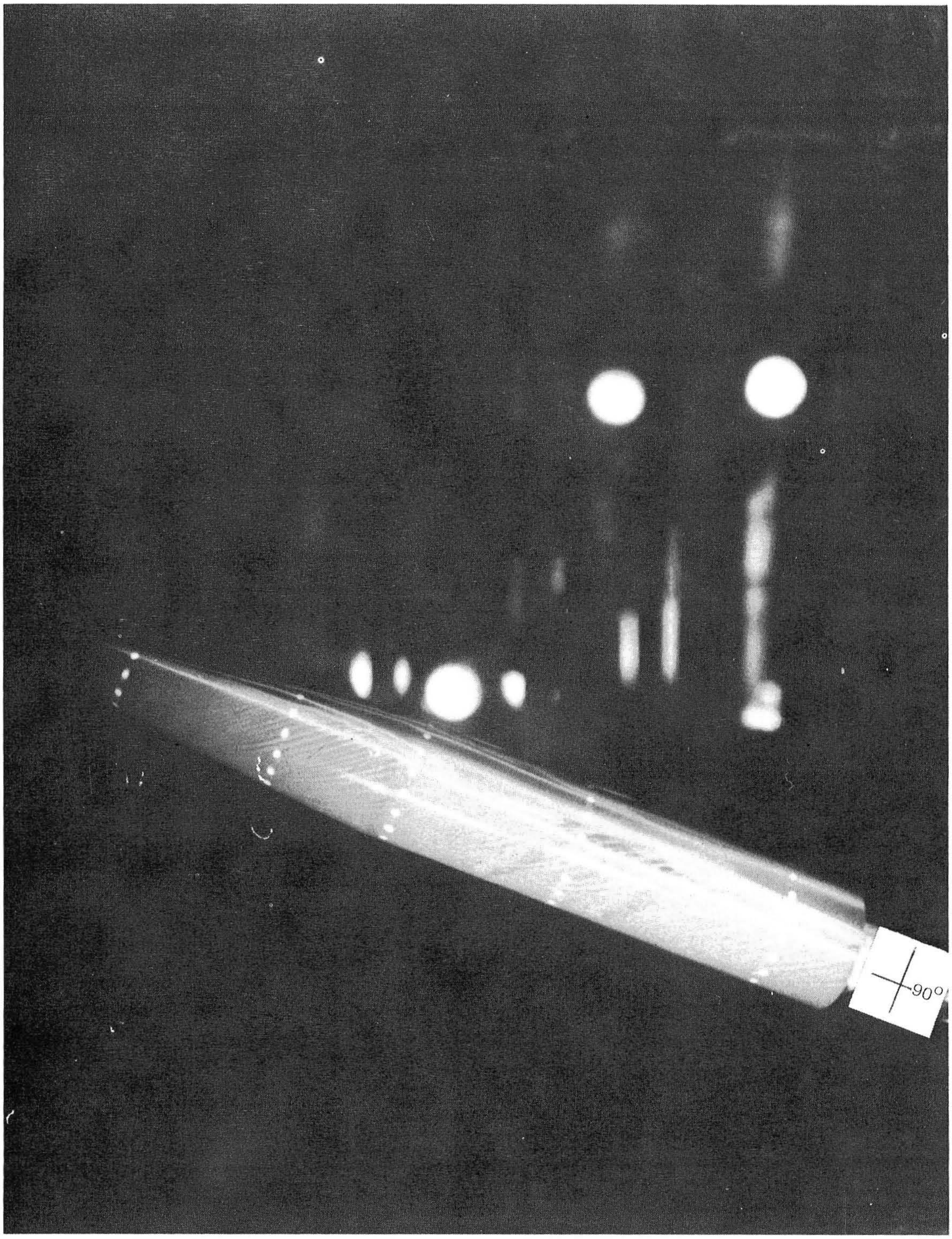
Figure 9.- Continued.



$\alpha = 12^{\circ}$

(c) $M_{\infty} = 2.96$.

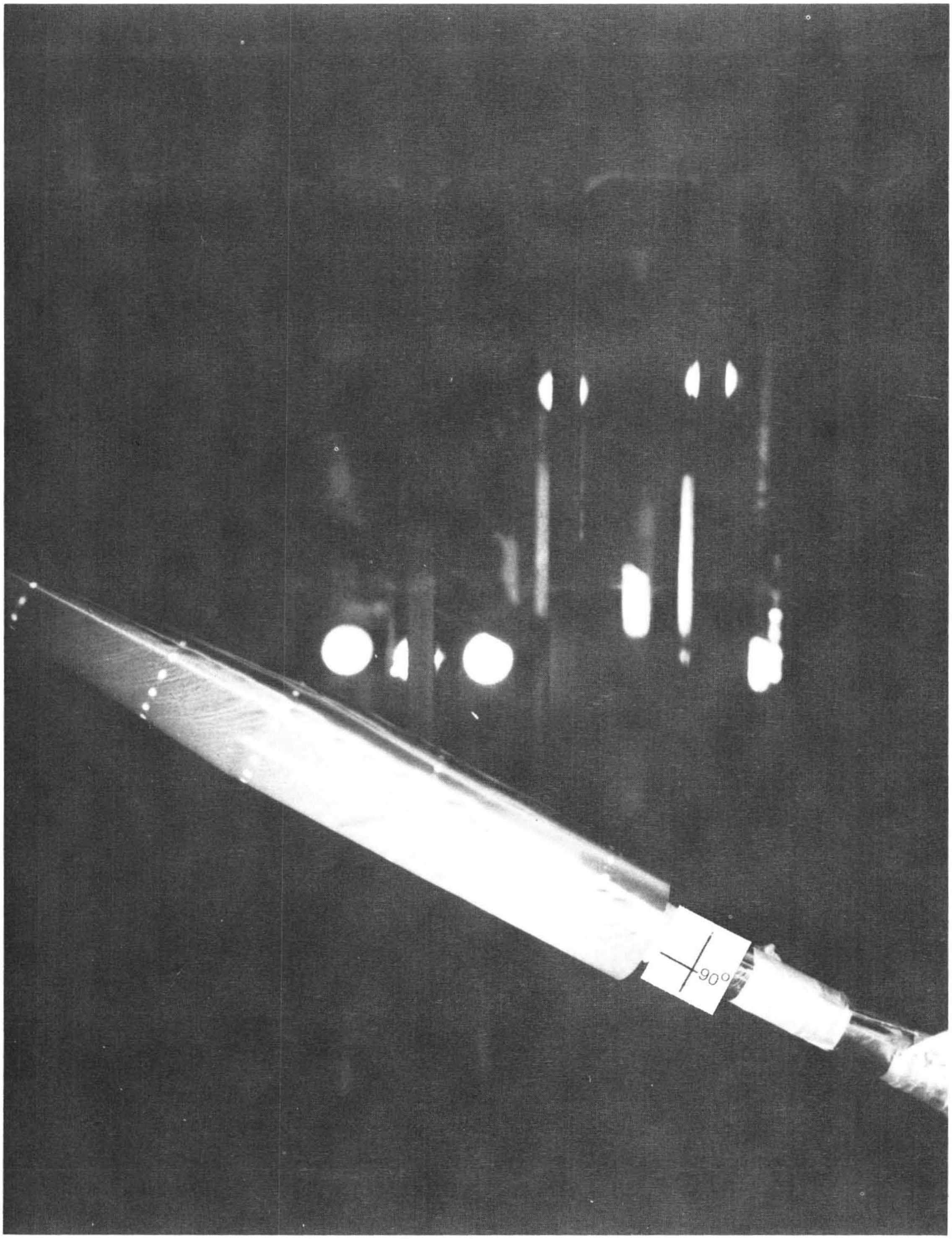
Figure 9.- Continued.



$\alpha = 20^{\circ}$

(c) Continued.

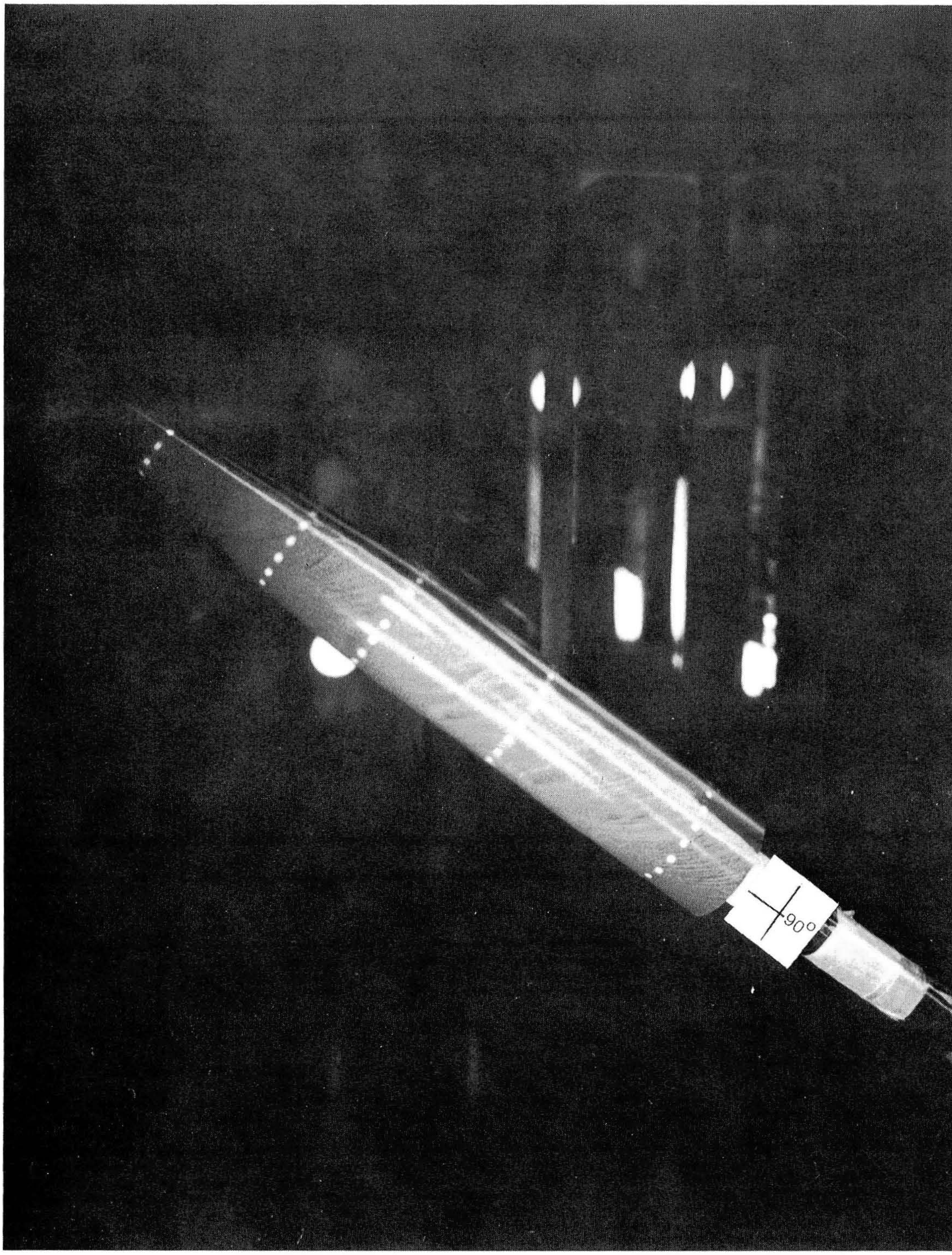
Figure 9.- Continued.



$\alpha = 28^{\circ}$

(c) Continued.

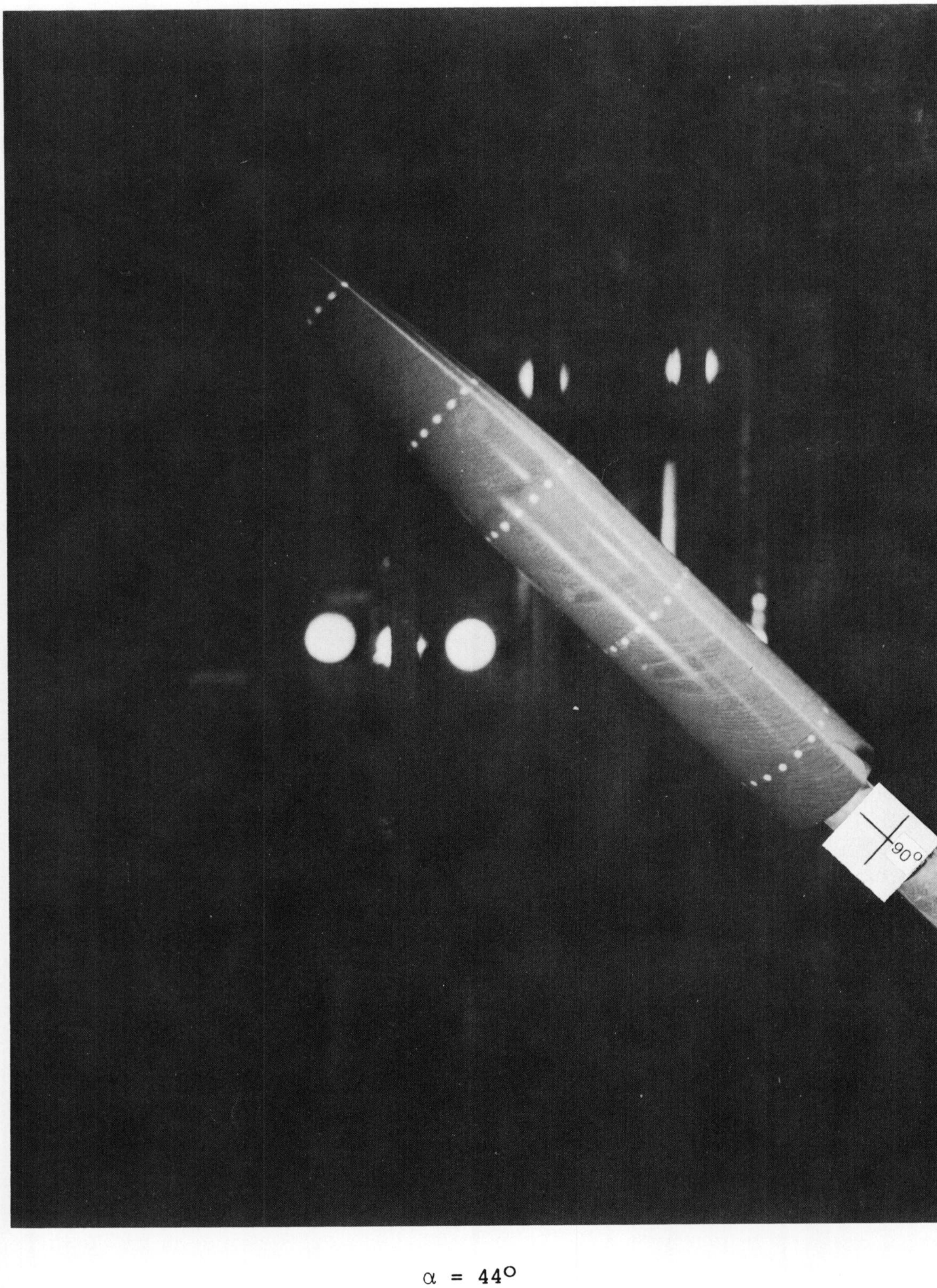
Figure 9.- Continued.



$\alpha = 36^{\circ}$

(c) Continued.

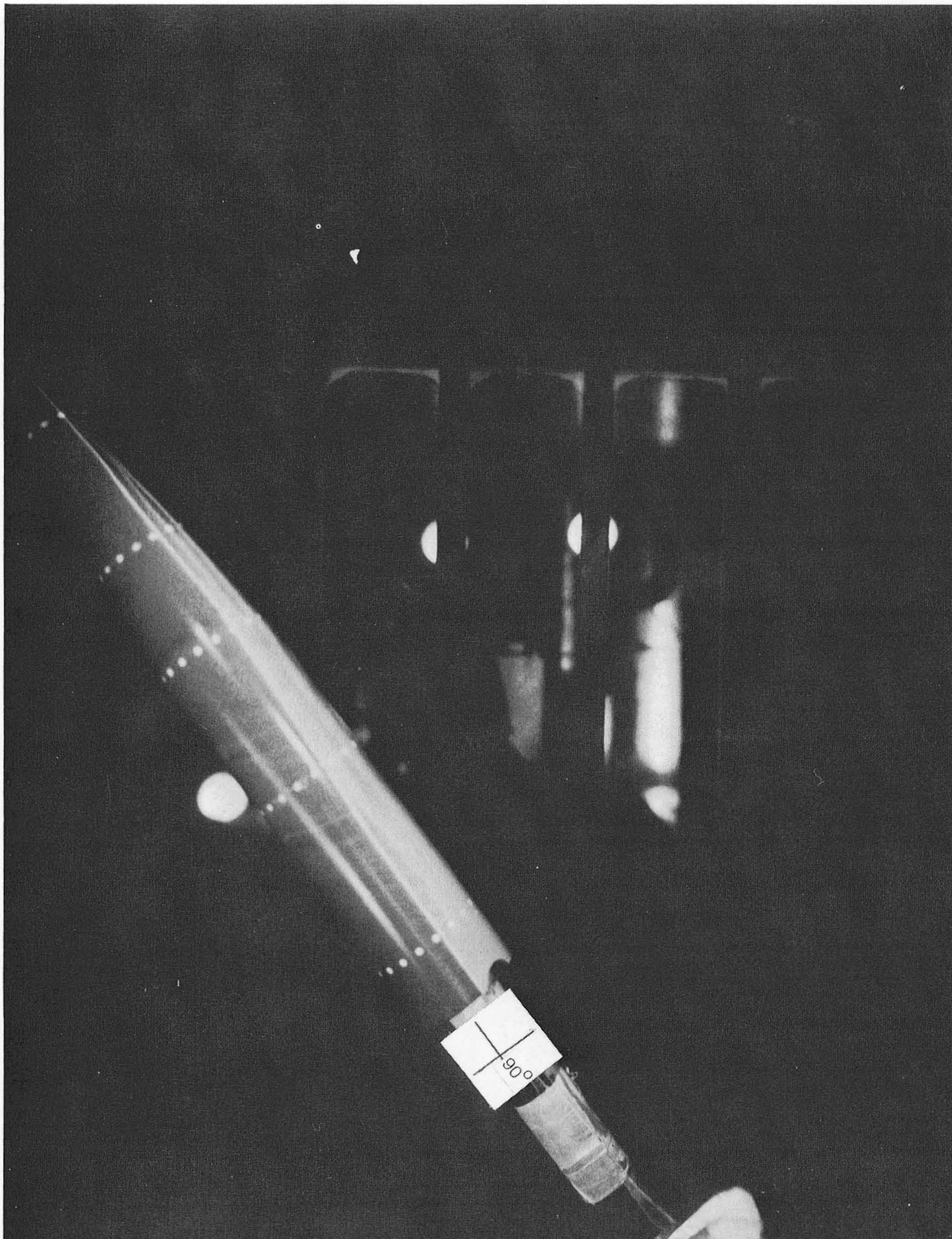
Figure 9.- Continued.



$\alpha = 44^{\circ}$

(c) Continued.

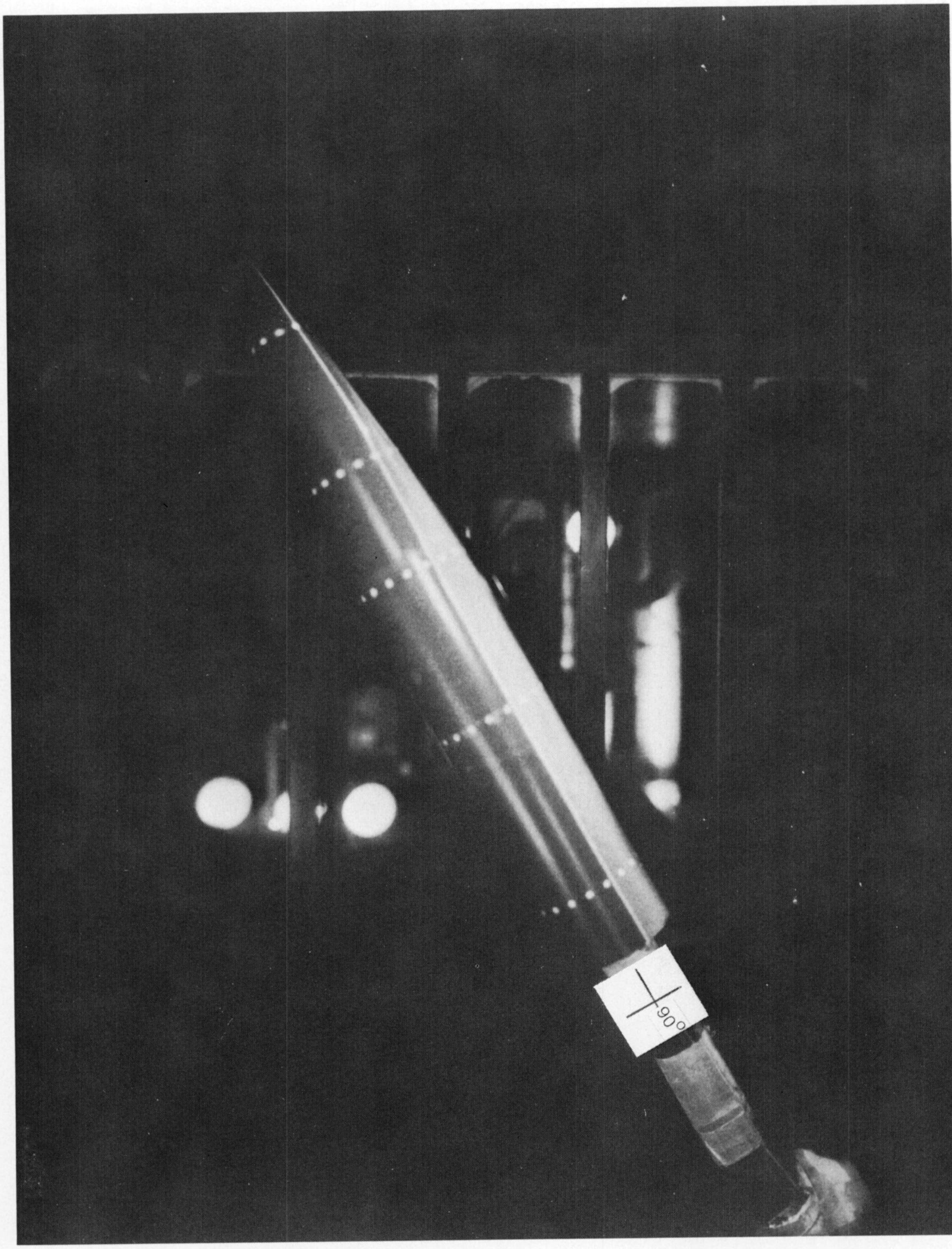
Figure 9.- Continued.



$\alpha = 52^{\circ}$

(c) Continued.

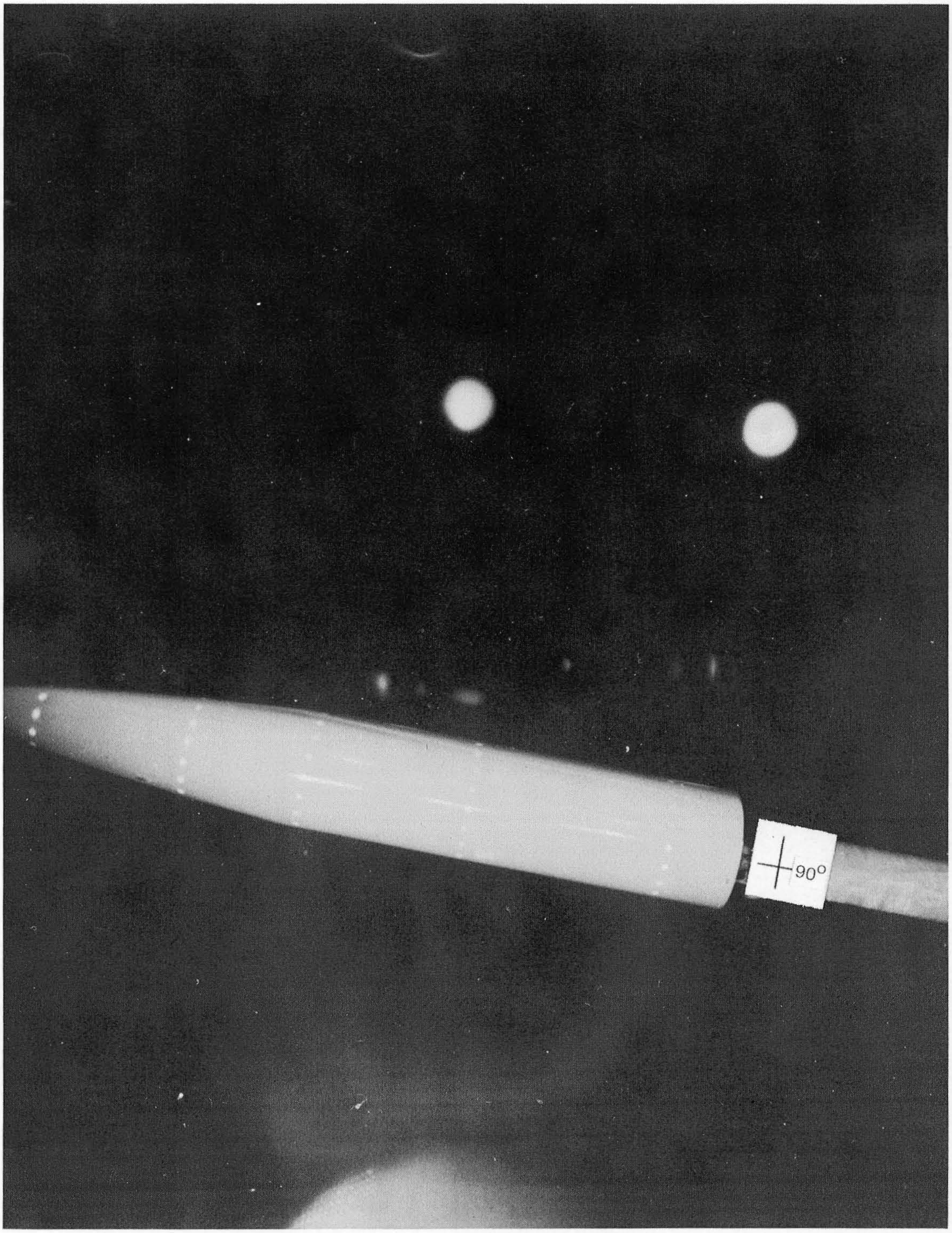
Figure 9.- Continued.



$\alpha = 60^{\circ}$

(c) Concluded.

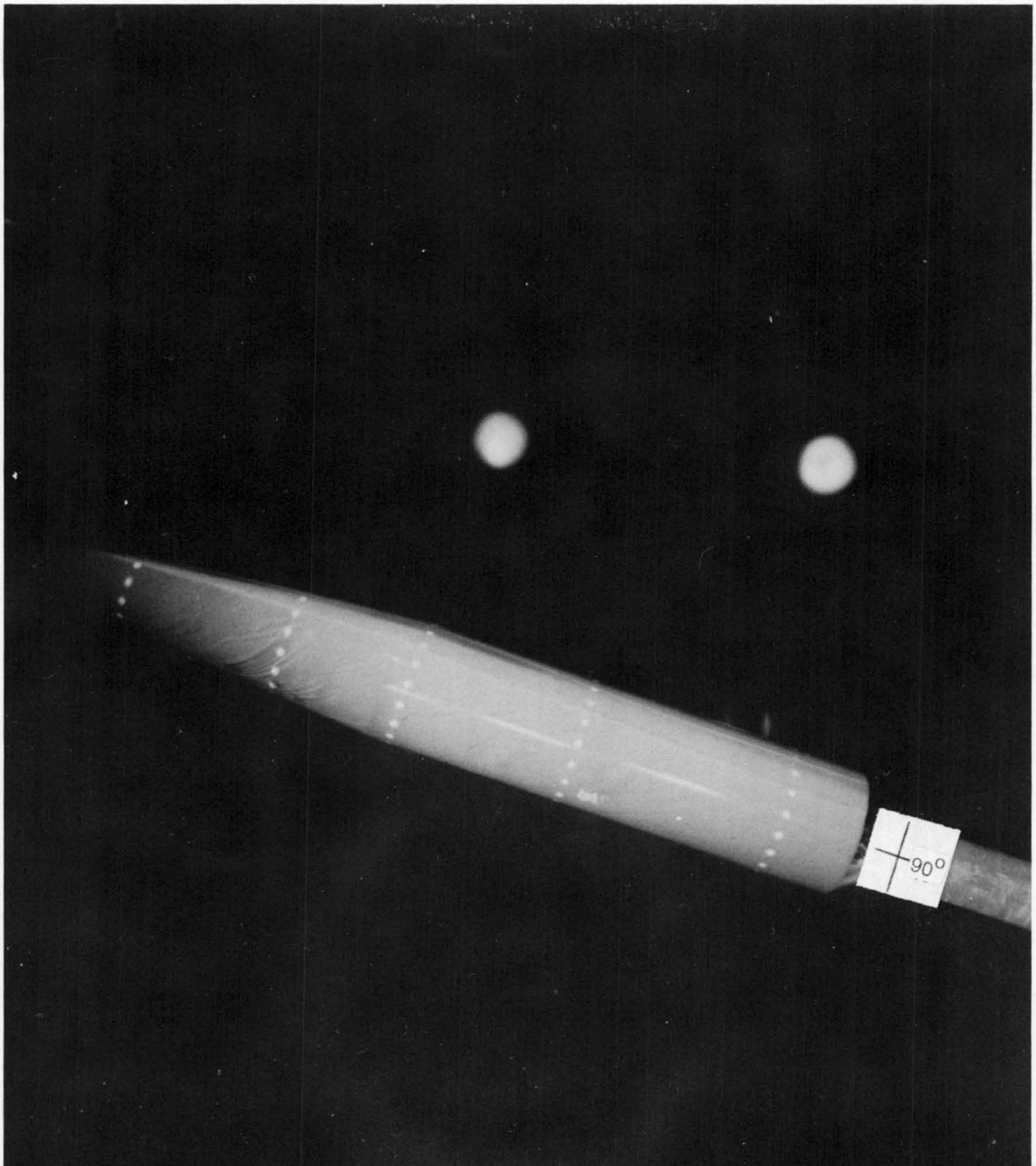
Figure 9.- Continued.



$\alpha = 12^{\circ}$

(d) $M_{\infty} = 4.63$.

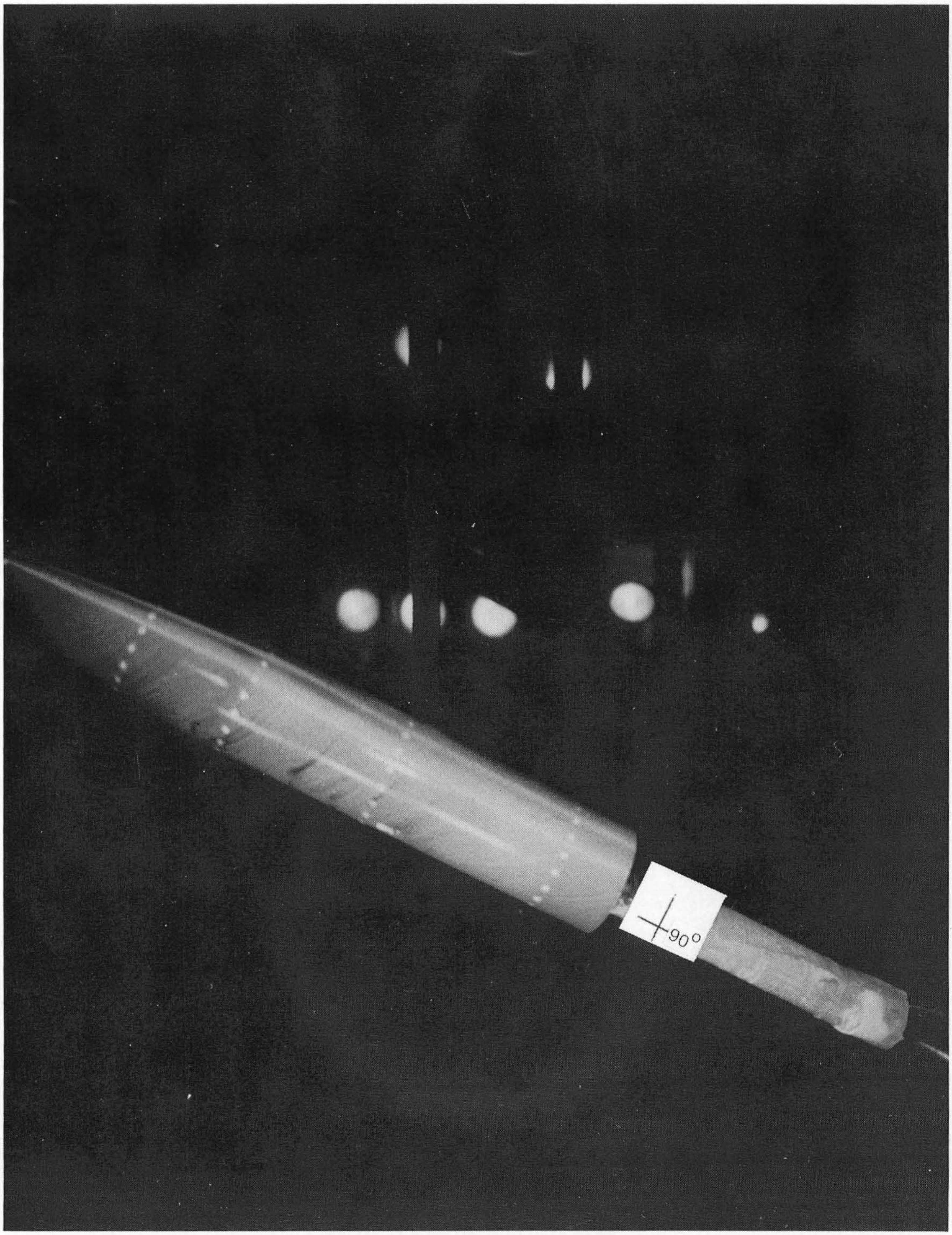
Figure 9.- Continued.



$\alpha = 20^{\circ}$

(d) Continued.

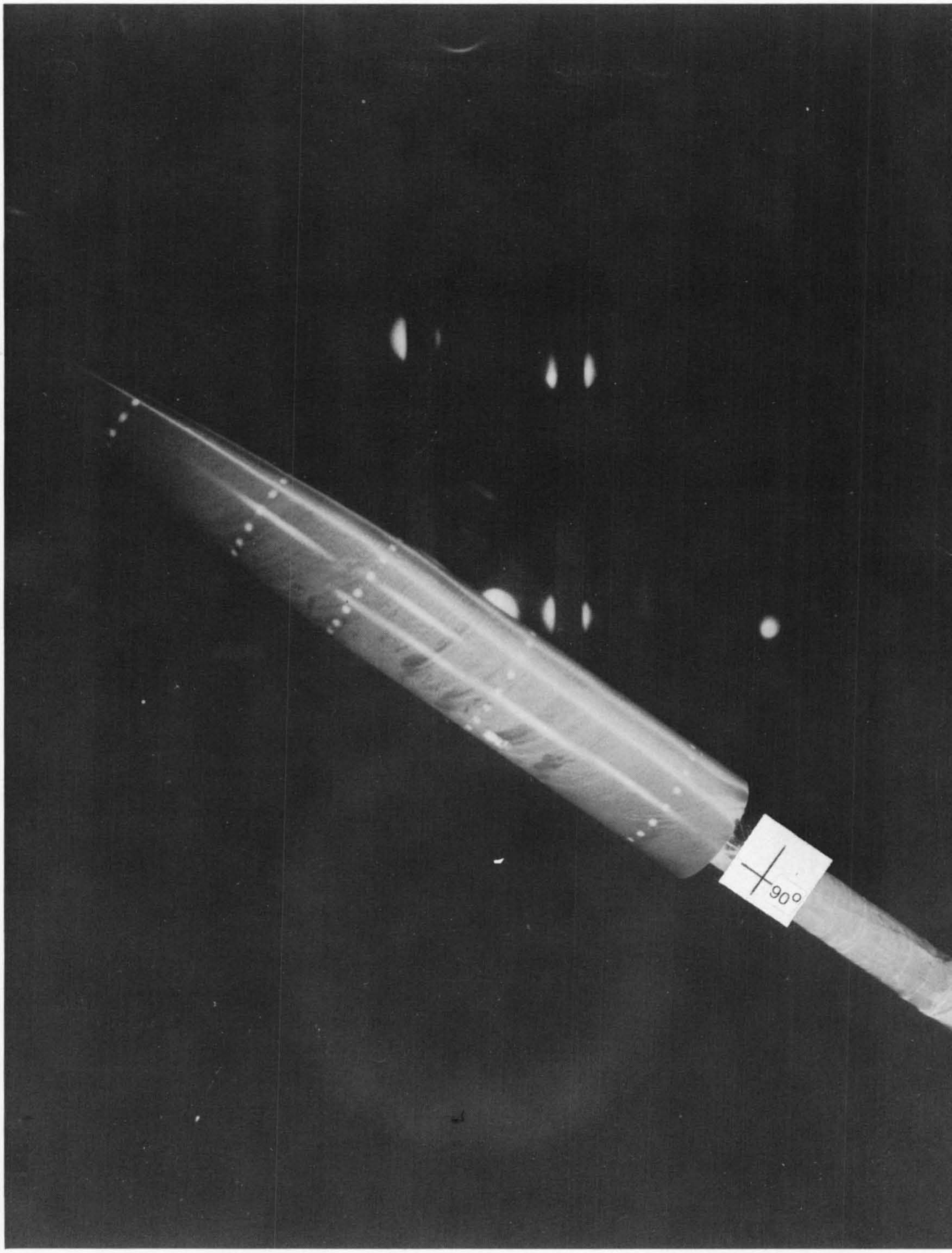
Figure 9.- Continued.



$\alpha = 28^{\circ}$

(d) Continued.

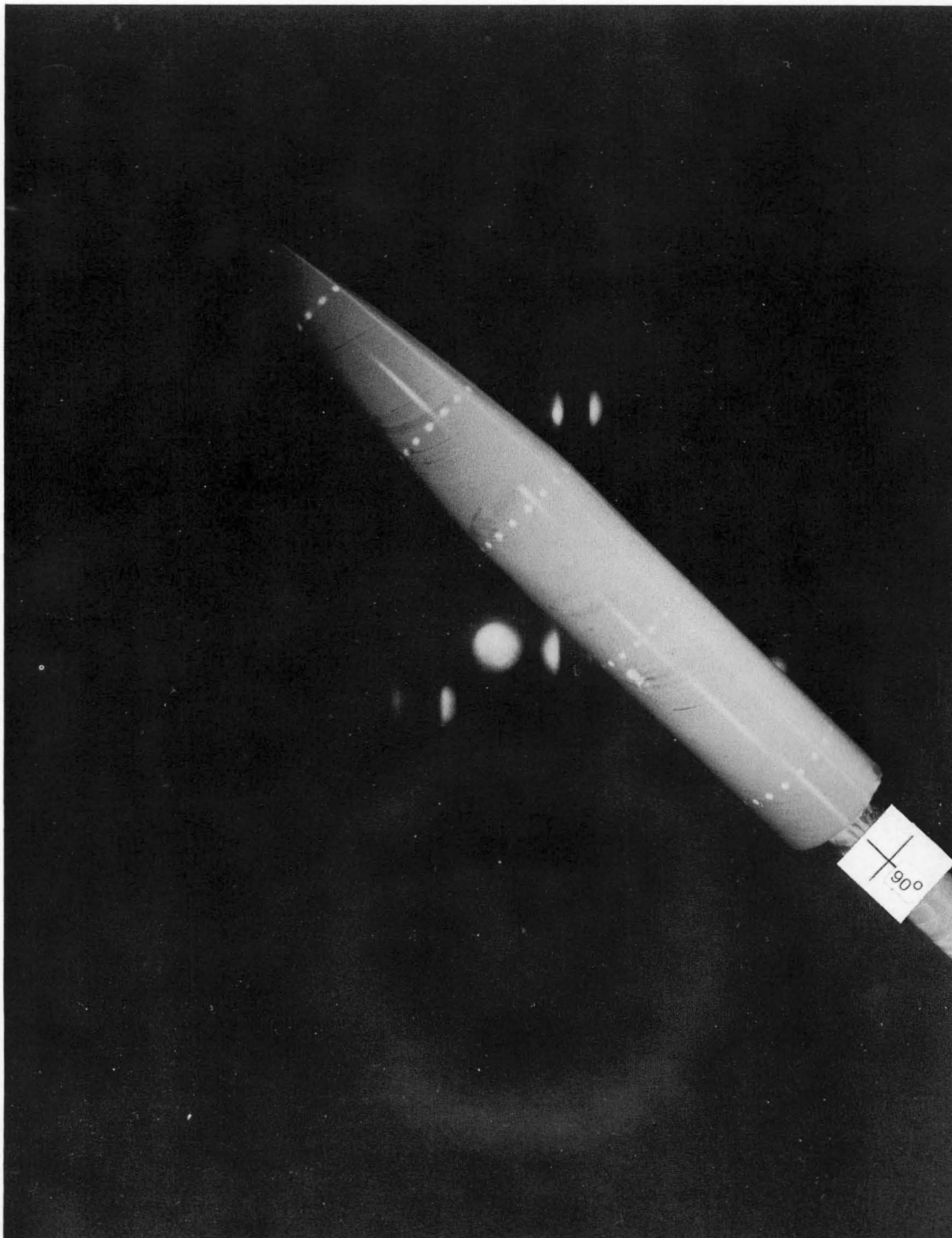
Figure 9.- Continued.



$\alpha = 36^{\circ}$

(d) Continued.

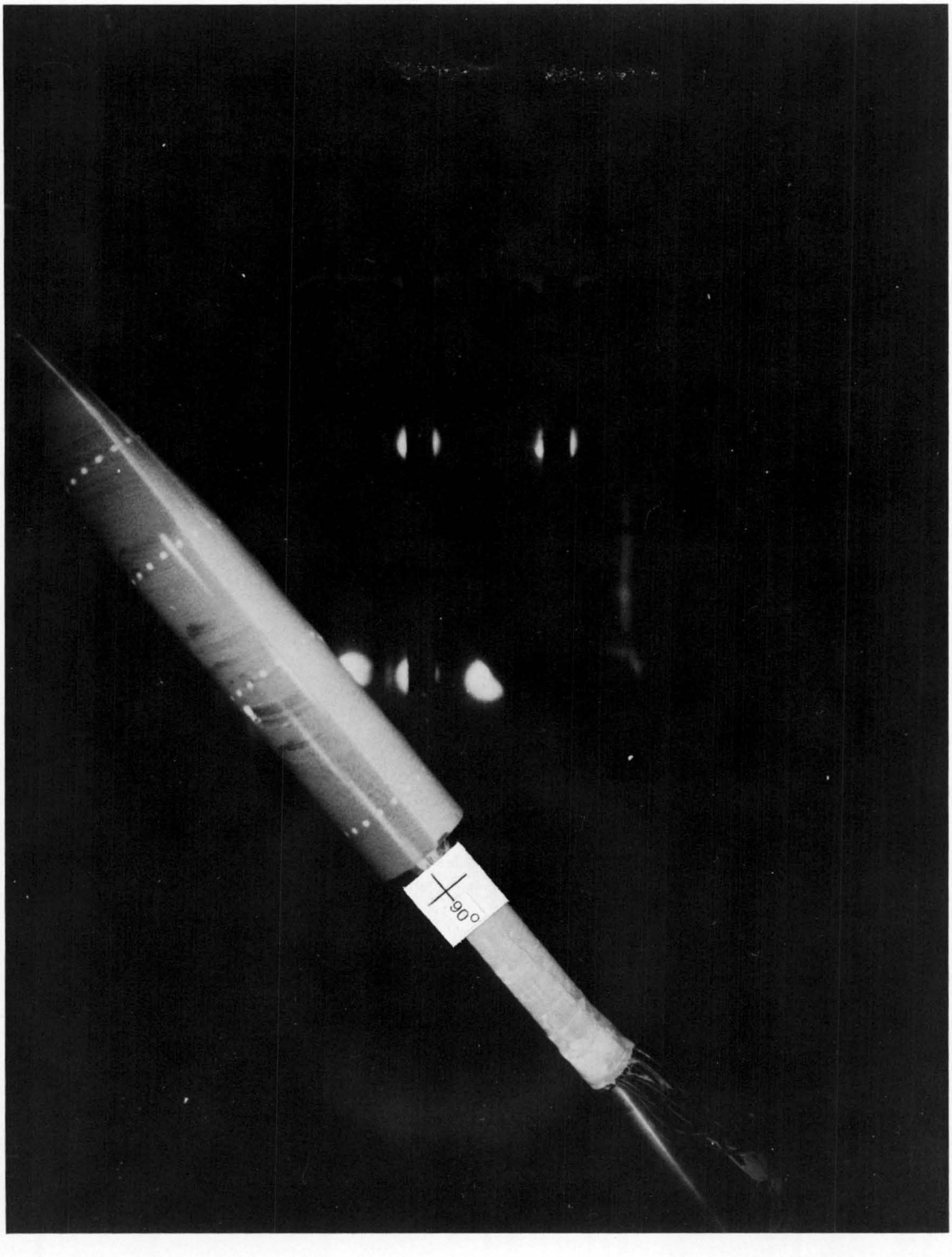
Figure 9.- Continued.



$\alpha = 44^{\circ}$

(d) Continued.

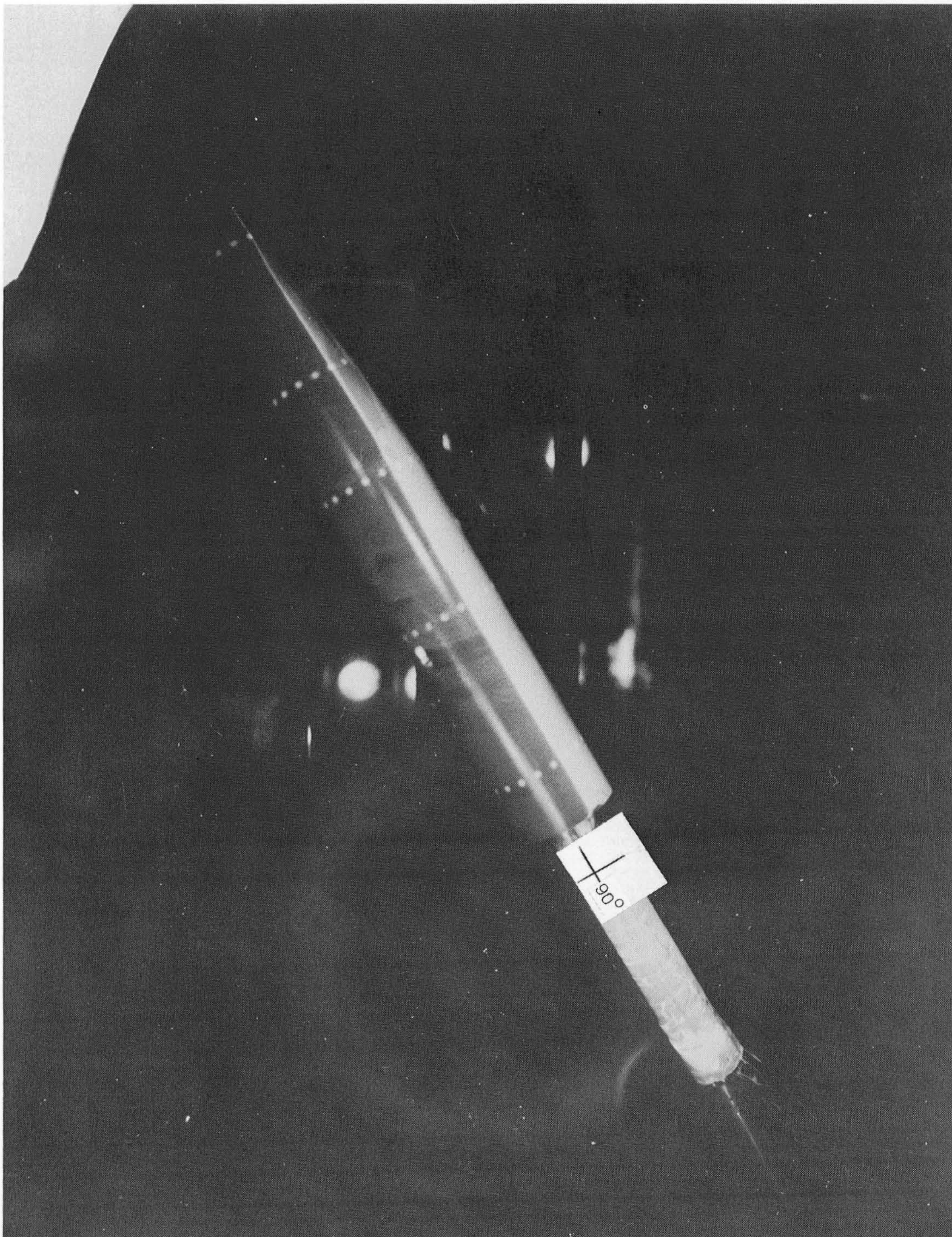
Figure 9.- Continued.



$\alpha = 52^{\circ}$

(d) Continued.

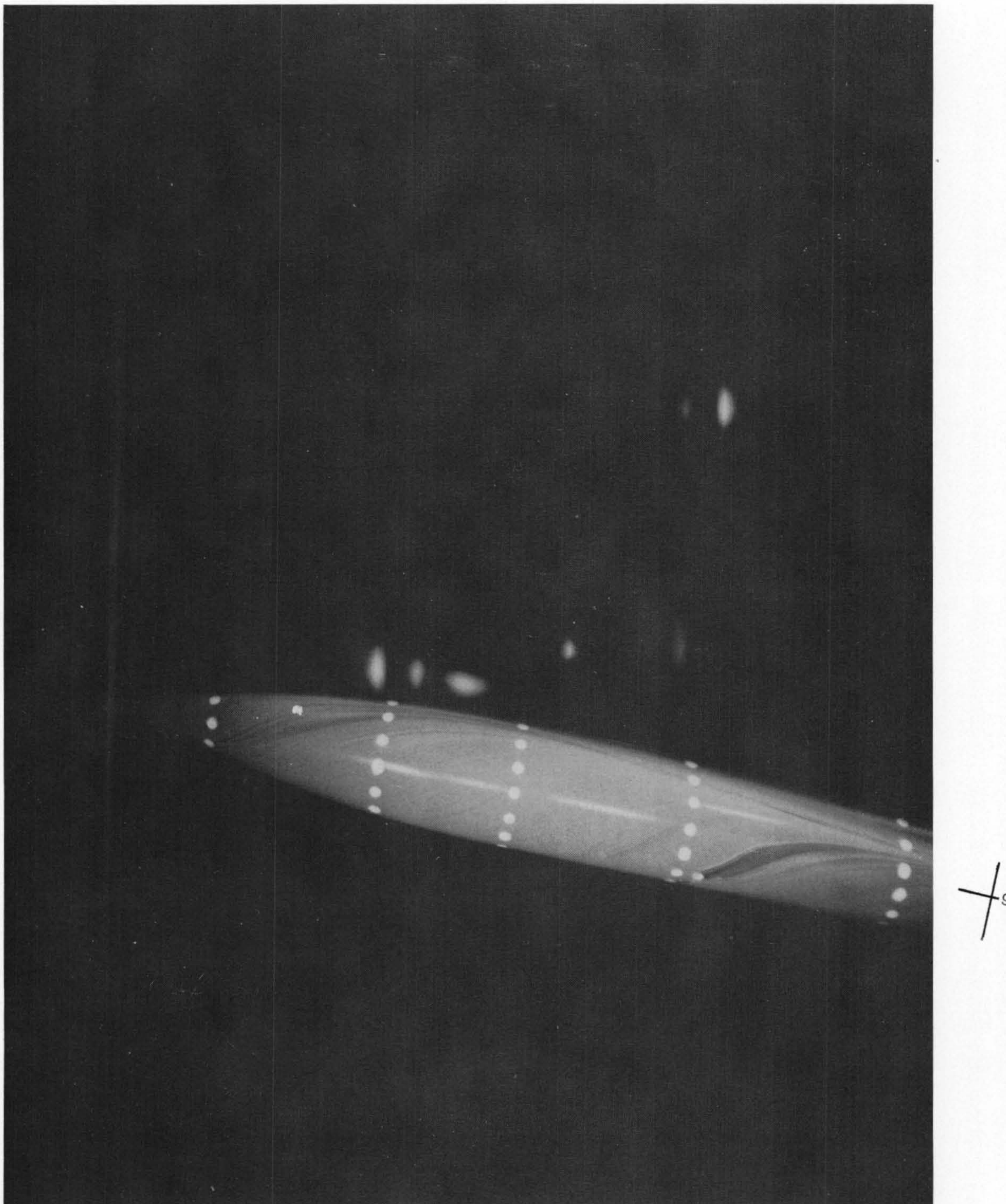
Figure 9.- Continued.



$\alpha = 60^{\circ}$

(d) Concluded.

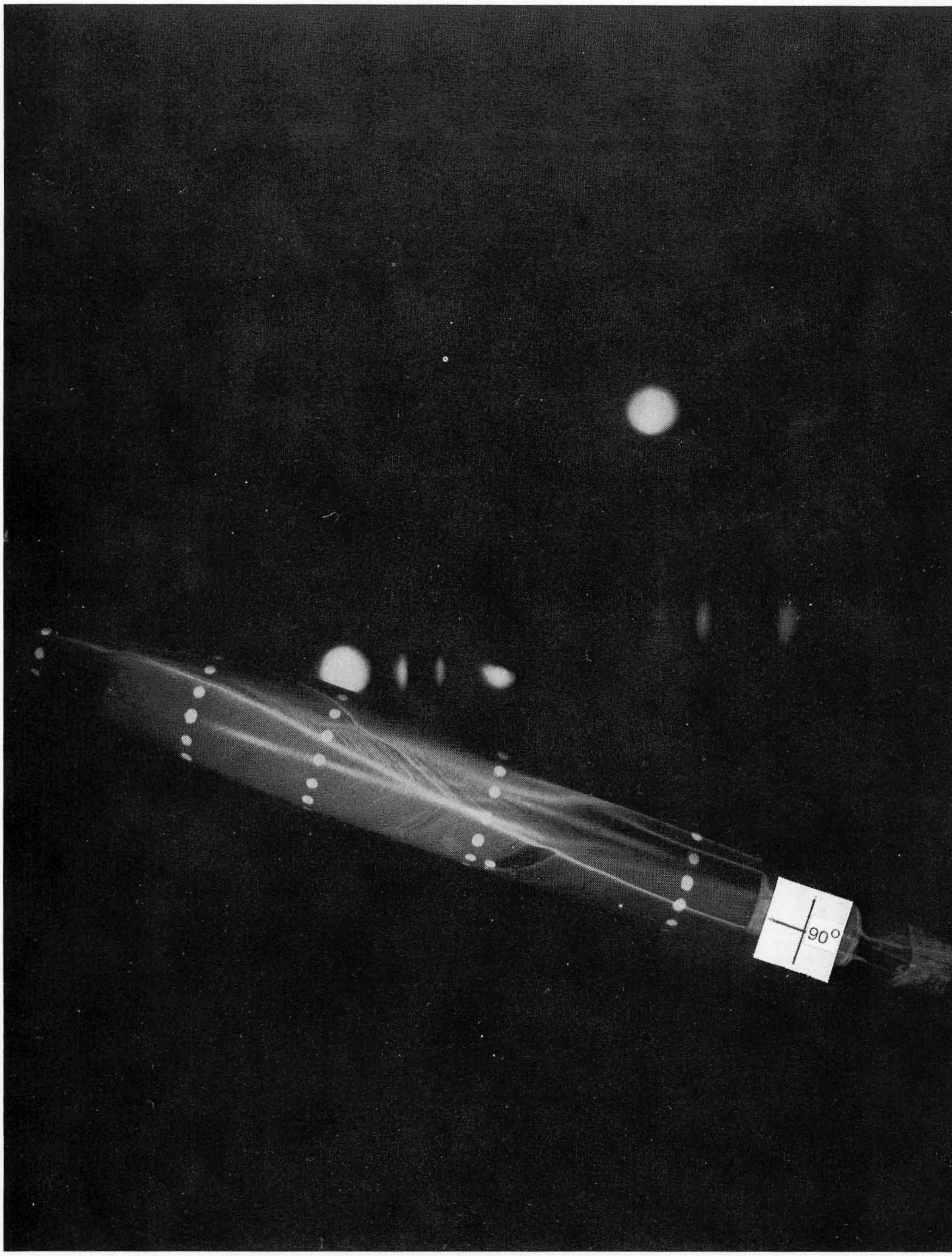
Figure 9.- Concluded.



$\alpha = 12^{\circ}$

(a) $M_{\infty} = 1.6$.

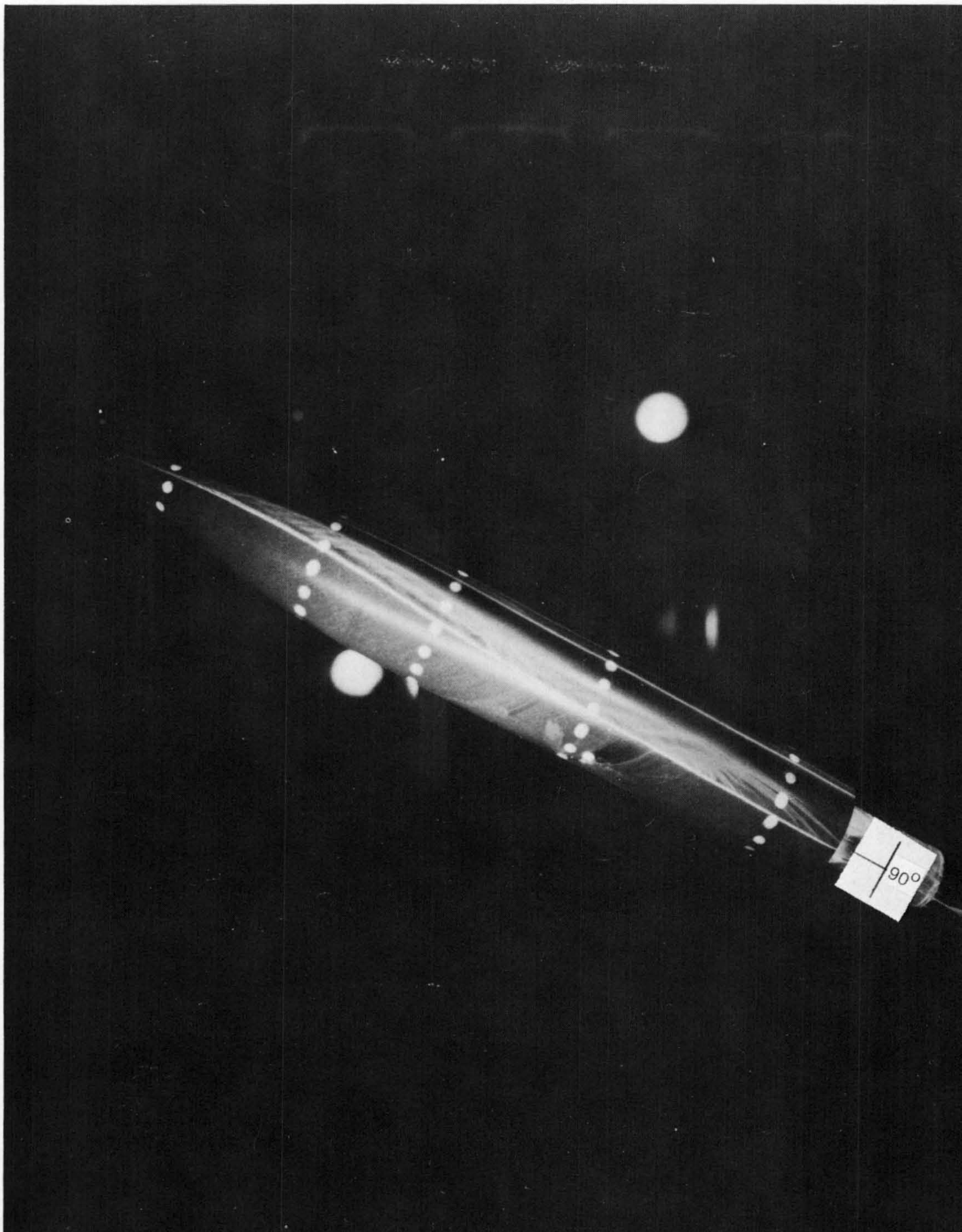
Figure 10.- Oil-flow photographs for circular-arc—circular-arc model.



$\alpha = 20^{\circ}$

(a) Continued.

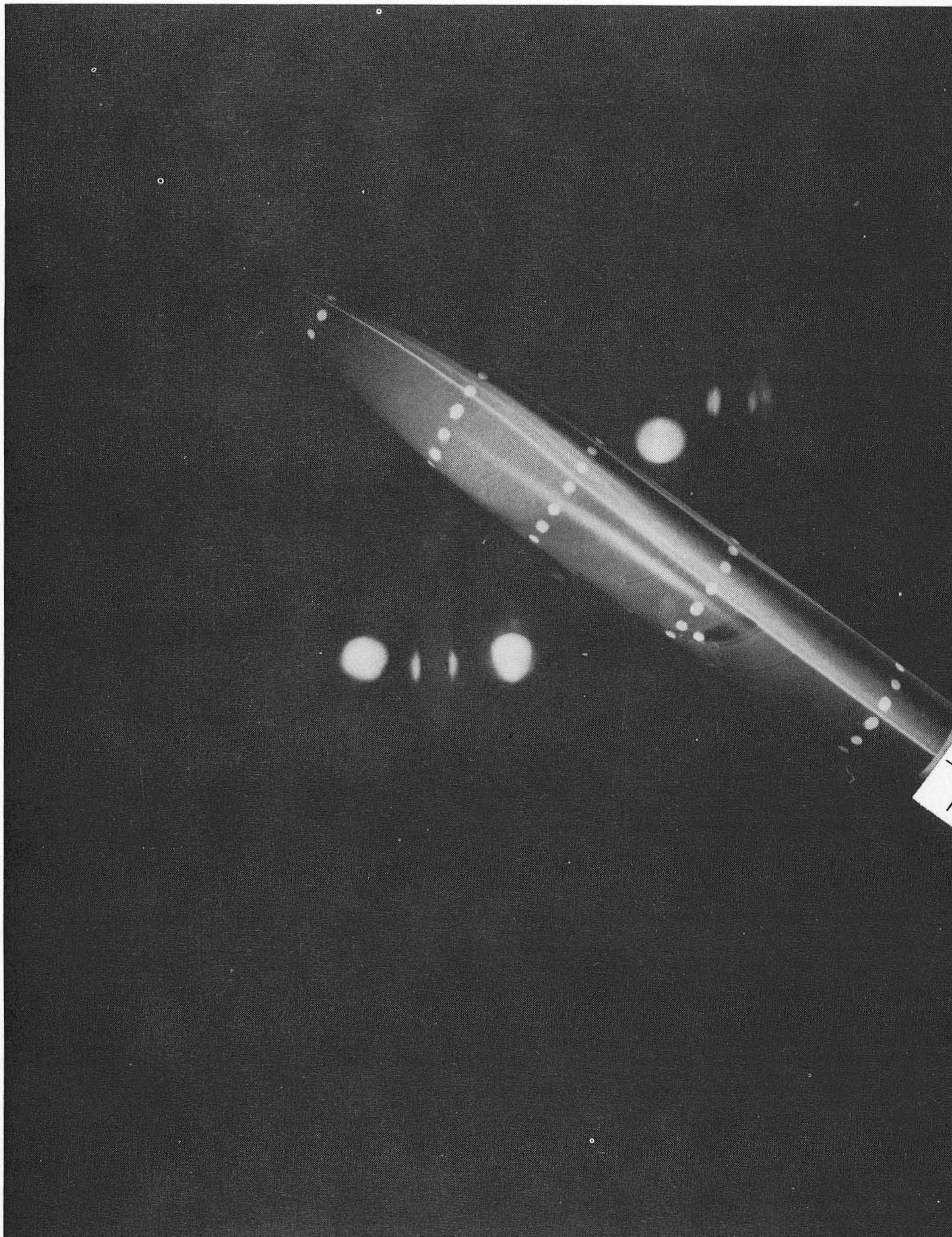
Figure 10.- Continued.



$\alpha = 28^{\circ}$

(a) Continued.

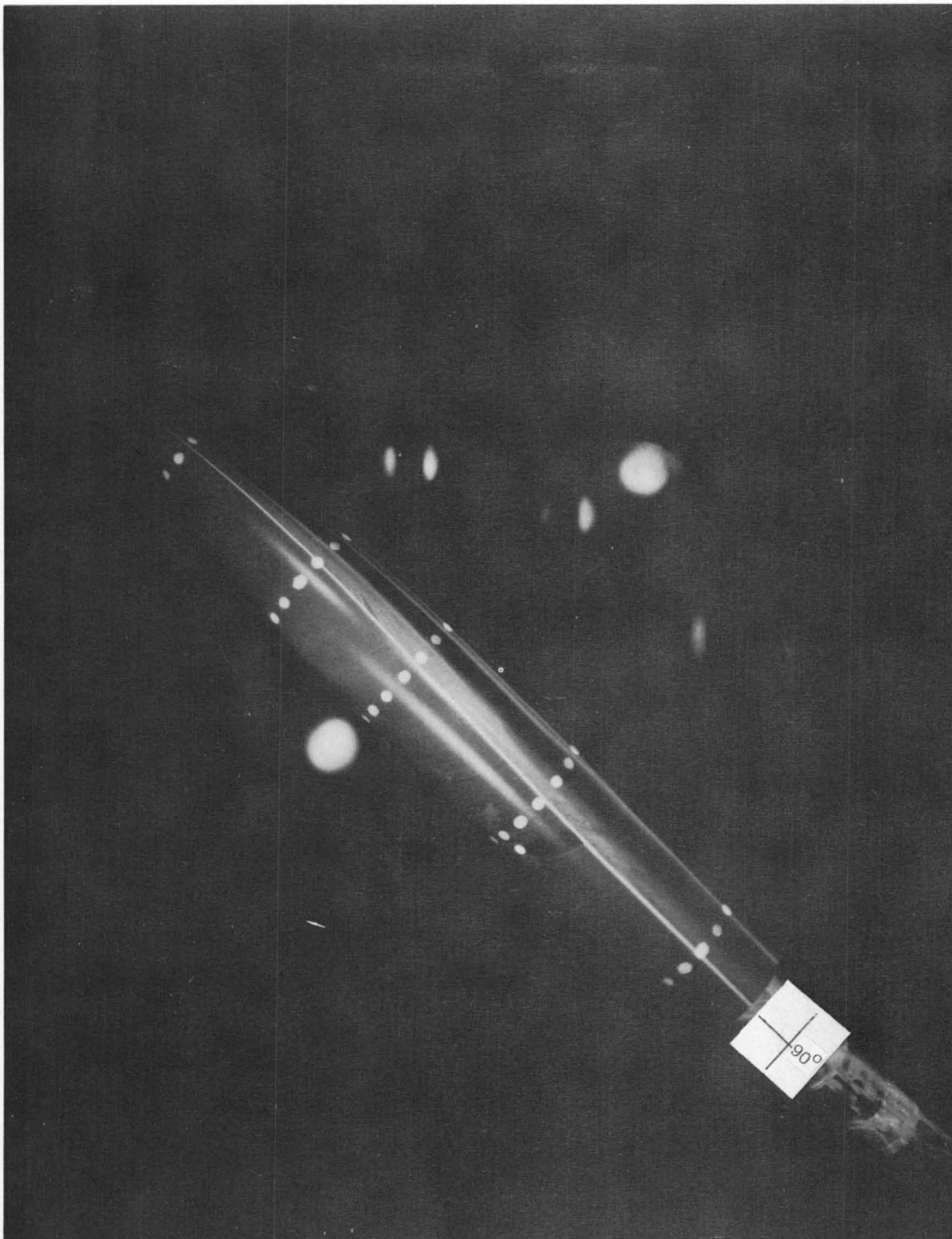
Figure 10.- Continued.



$\alpha = 36^{\circ}$

(a) Continued.

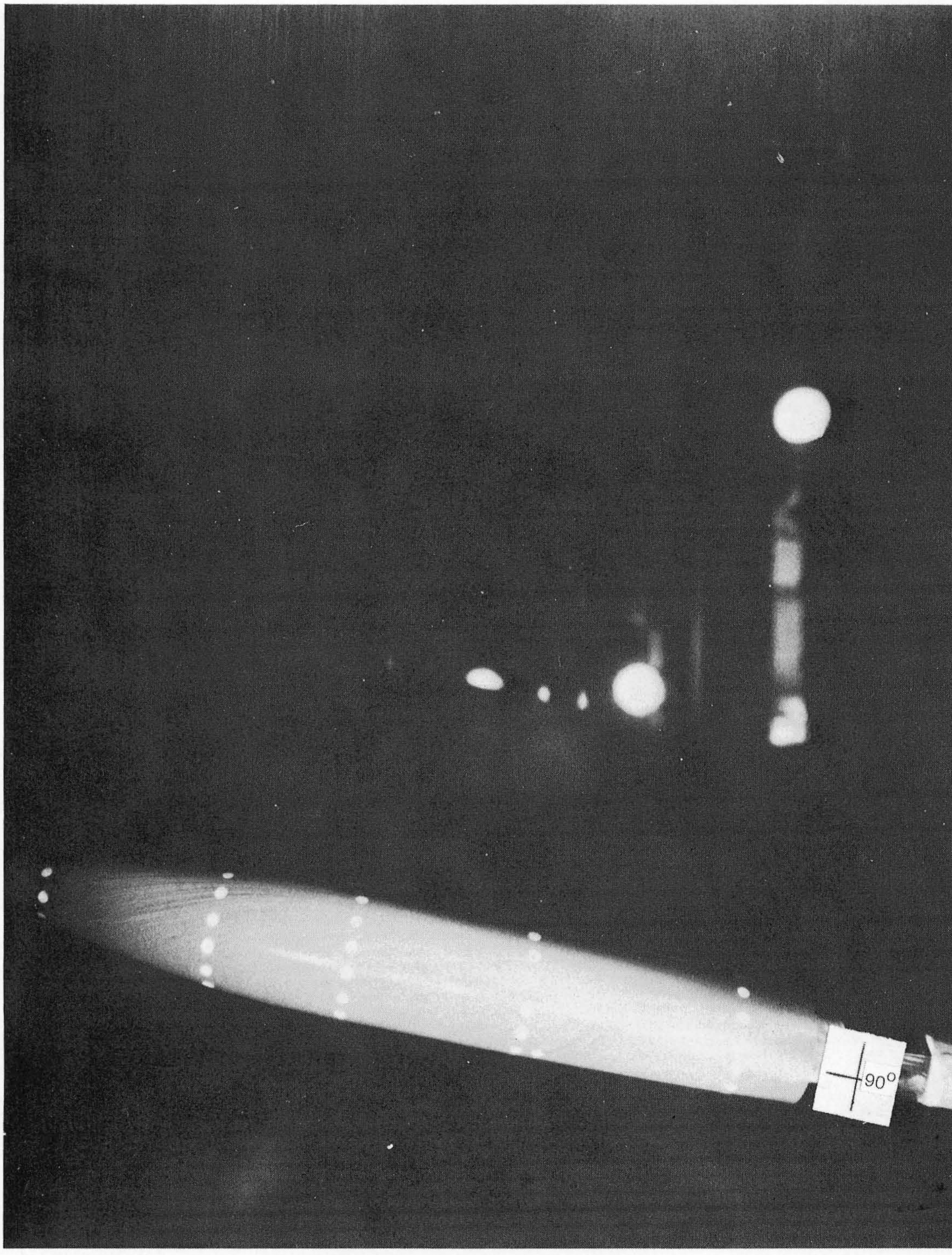
Figure 10.- Continued.



$\alpha = 44^{\circ}$

(a) Concluded.

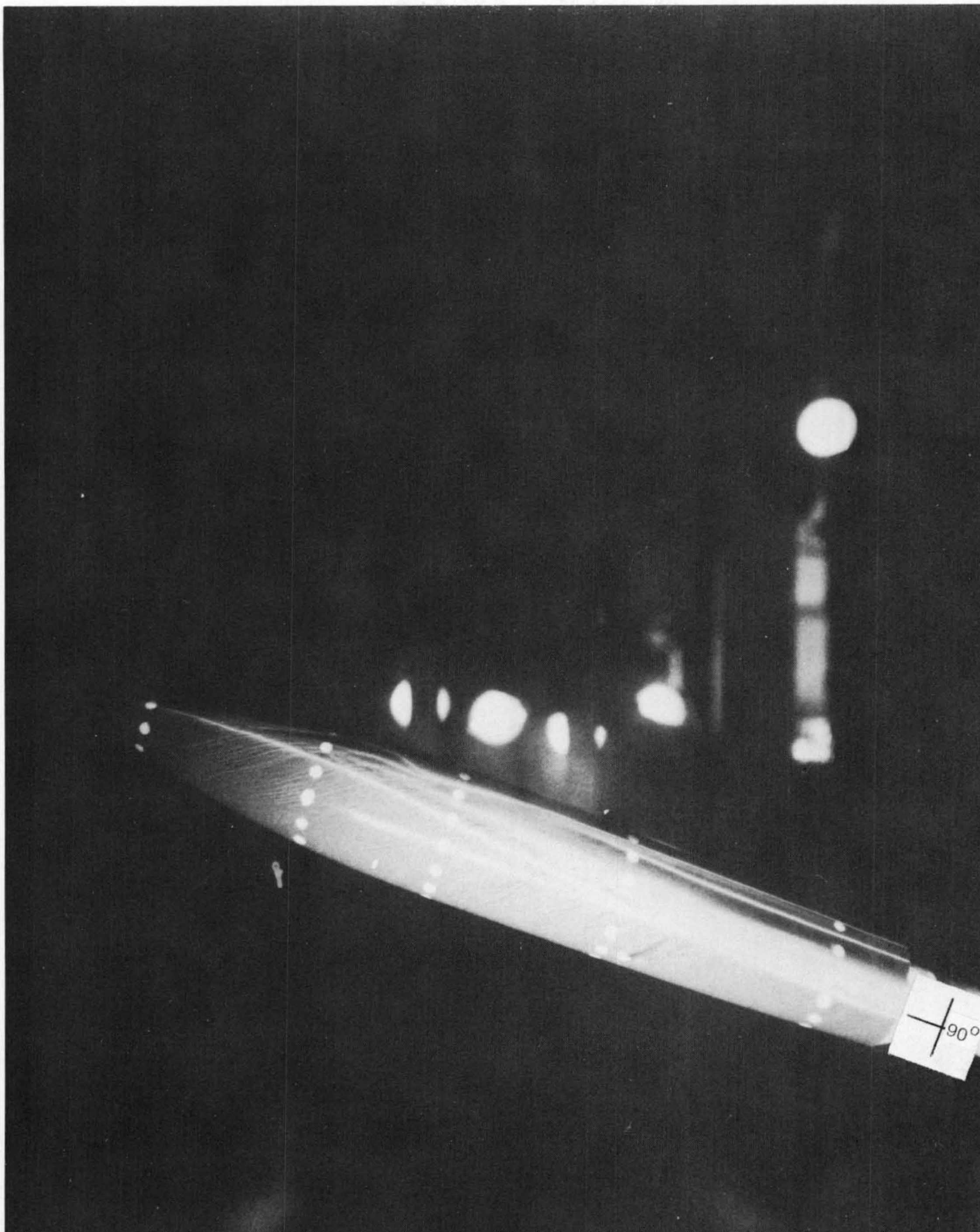
Figure 10.- Continued.



$\alpha = 12^{\circ}$

(b) $M_{\infty} = 2.3$.

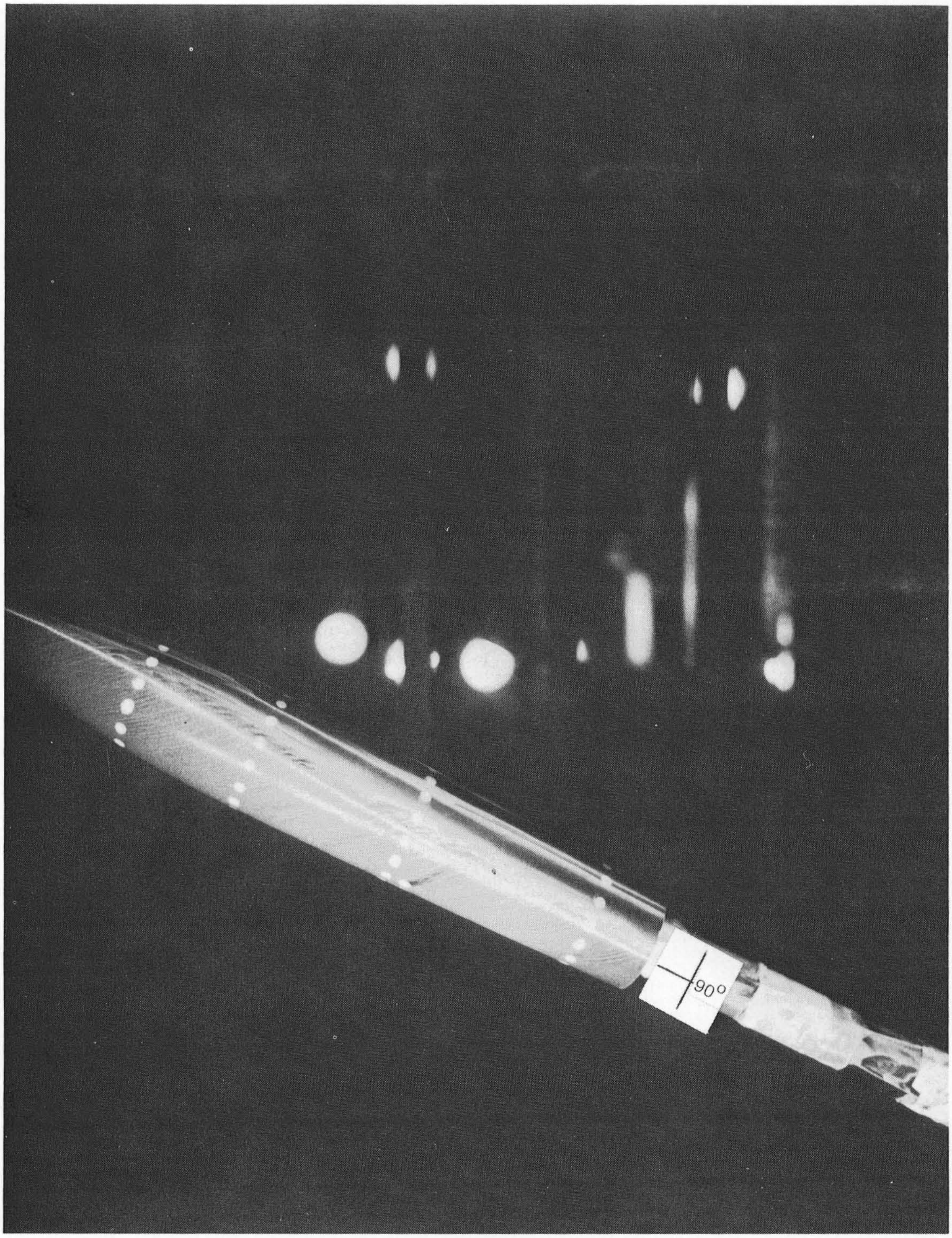
Figure 10.- Continued.



$\alpha = 20^{\circ}$

(b) Continued.

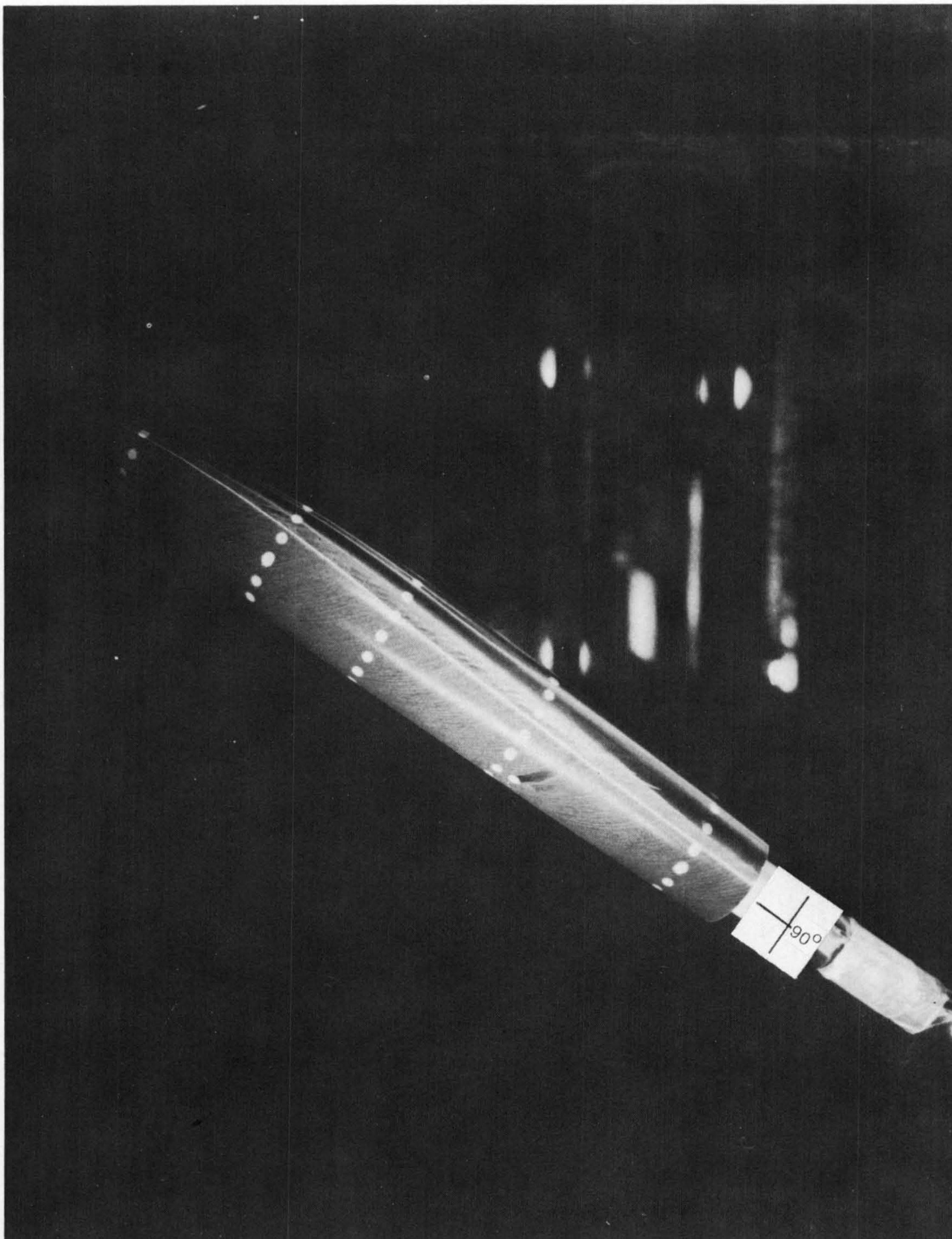
Figure 10.- Continued.



$\alpha = 28^{\circ}$

(b) Continued.

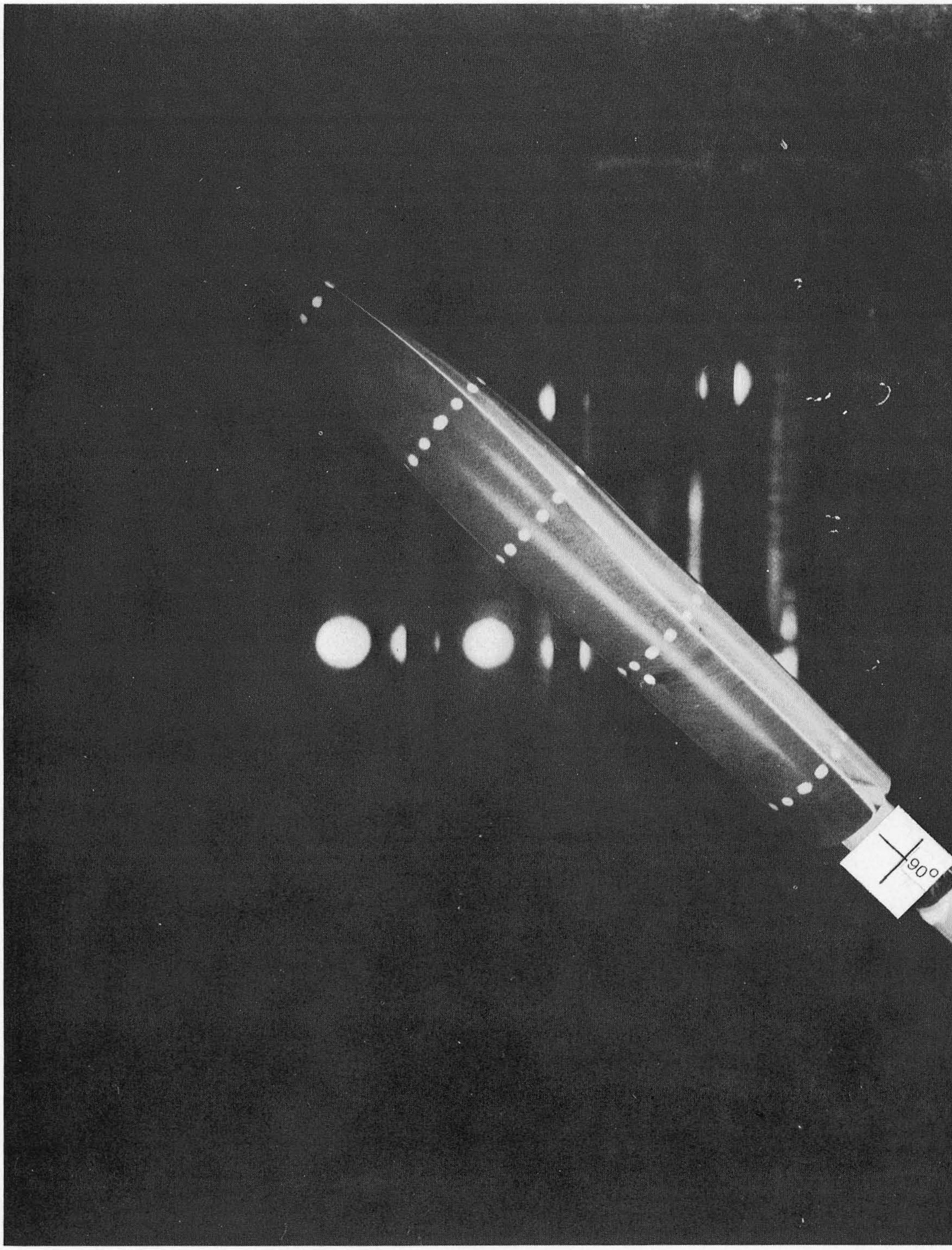
Figure 10.- Continued.



α = 36°

(b) Continued.

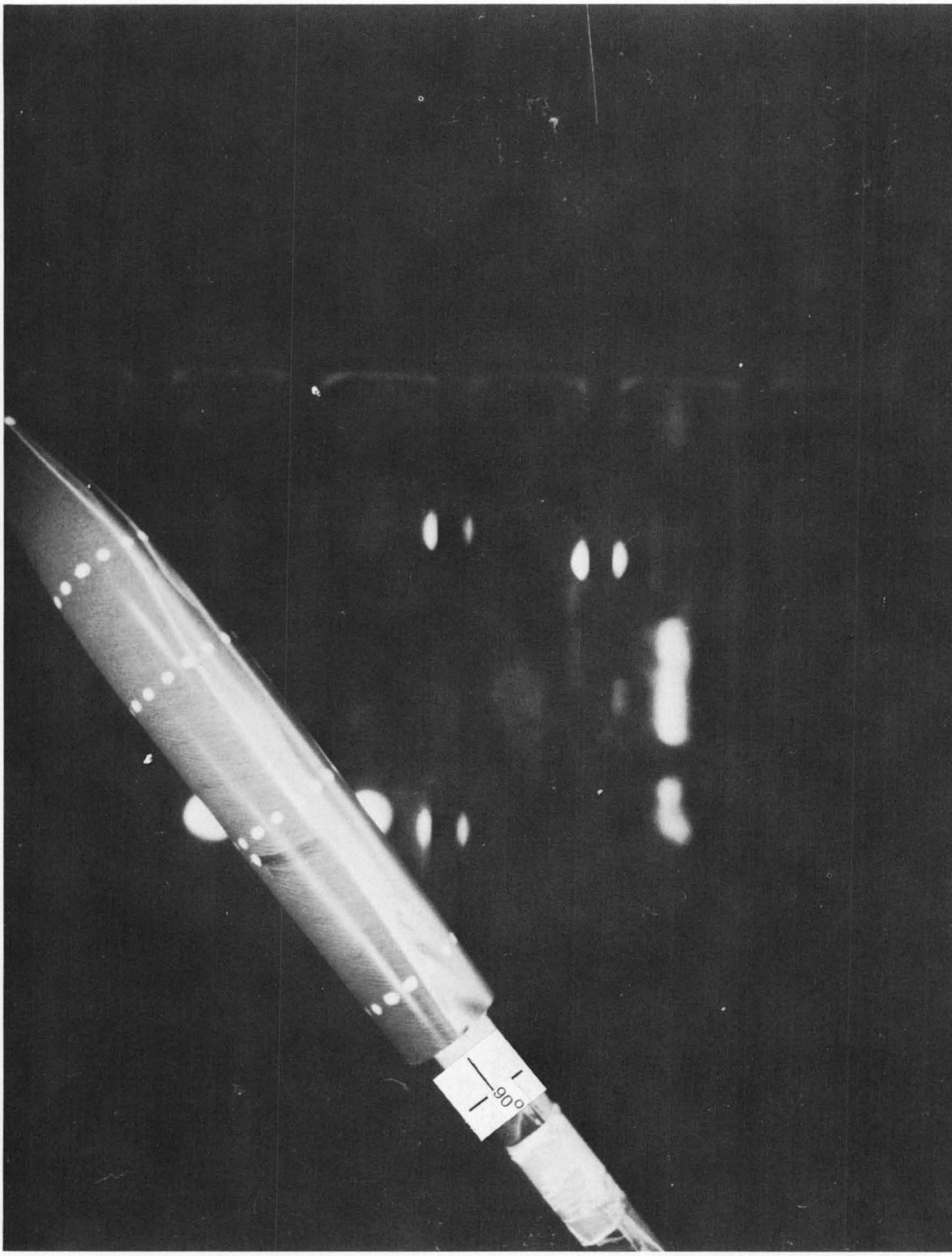
Figure 10.- Continued.



$\alpha = 44^{\circ}$

(b) Continued.

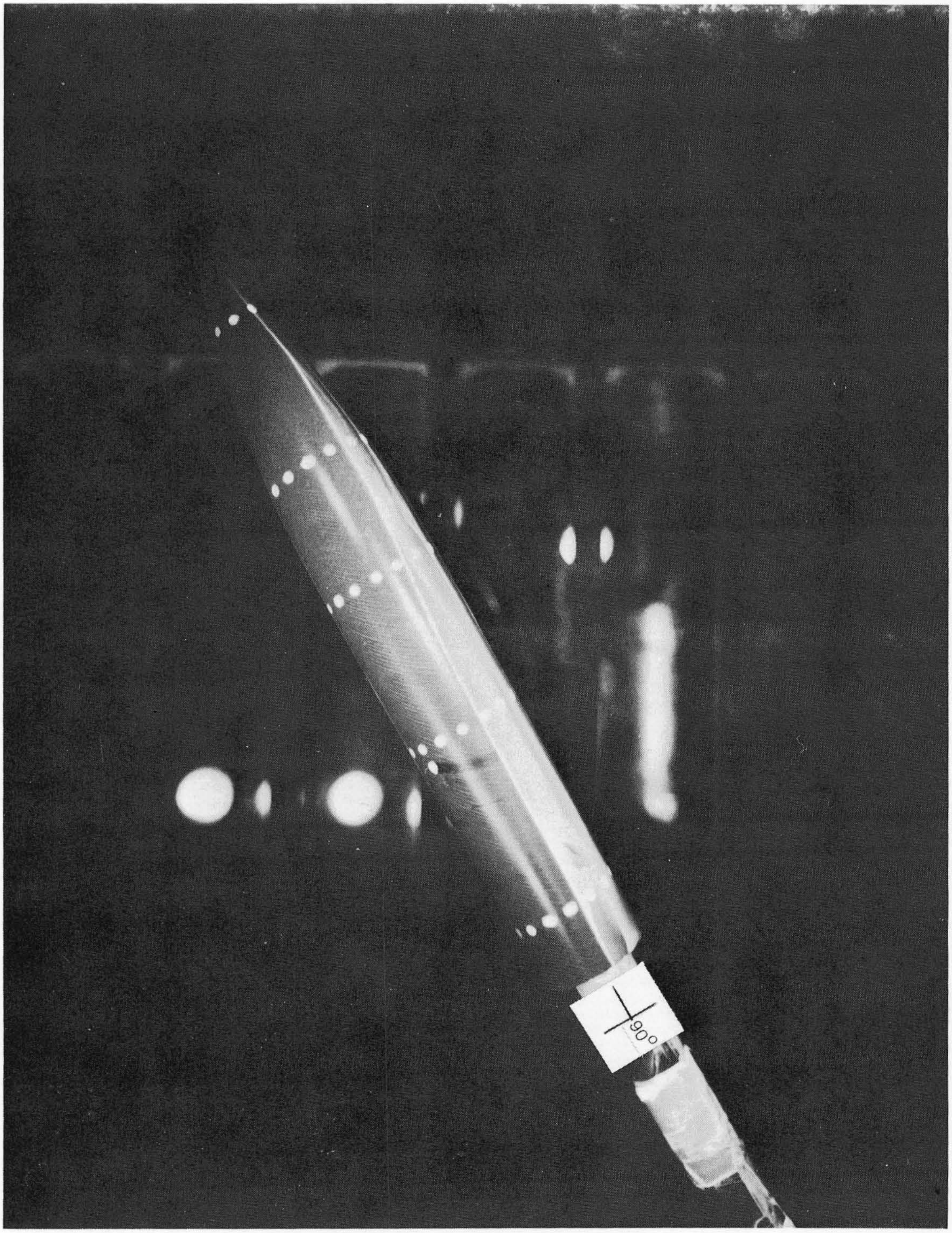
Figure 10.- Continued.



$\alpha = 52^{\circ}$

(b) Continued.

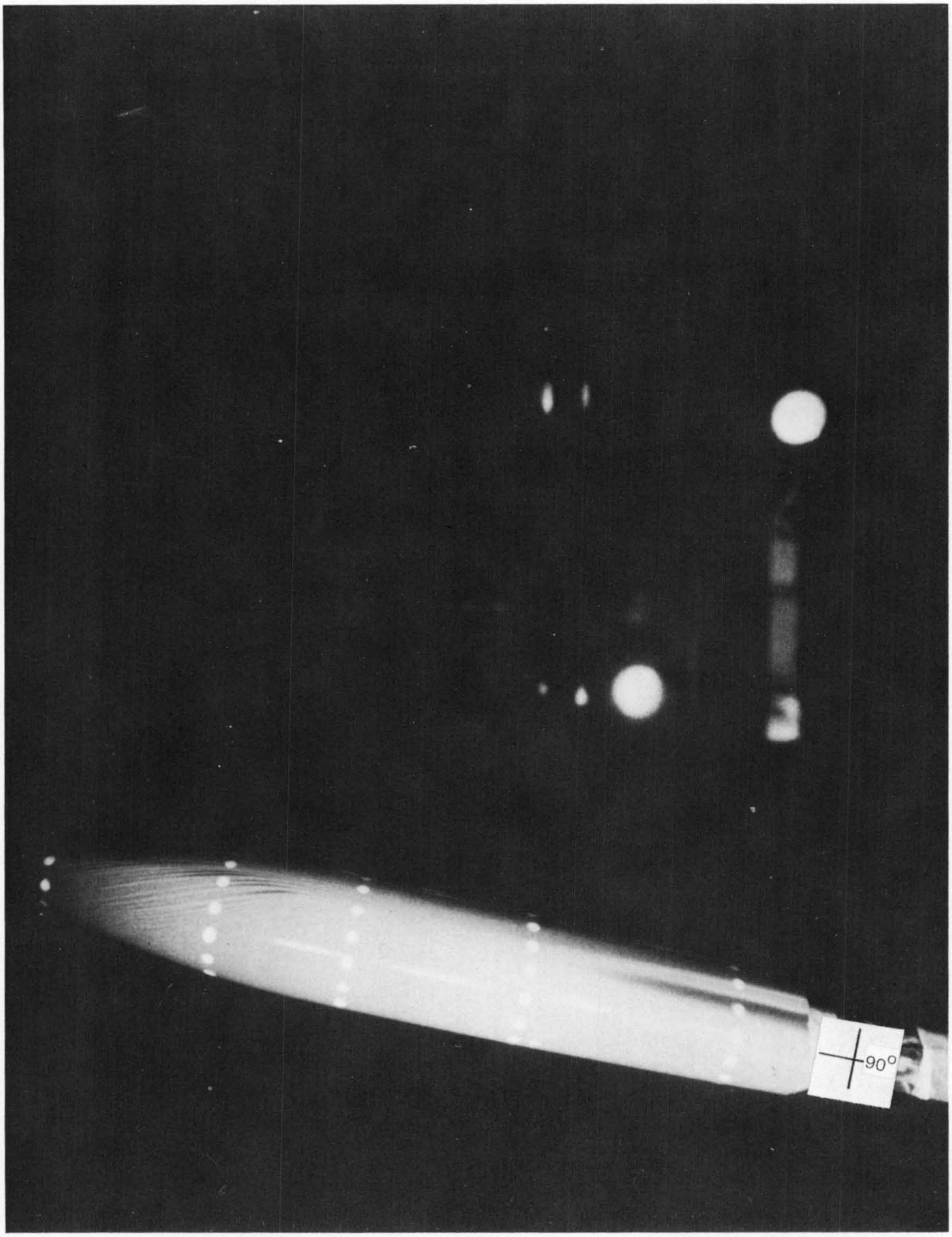
Figure 10.- Continued.



$\alpha = 60^{\circ}$

(b) Concluded.

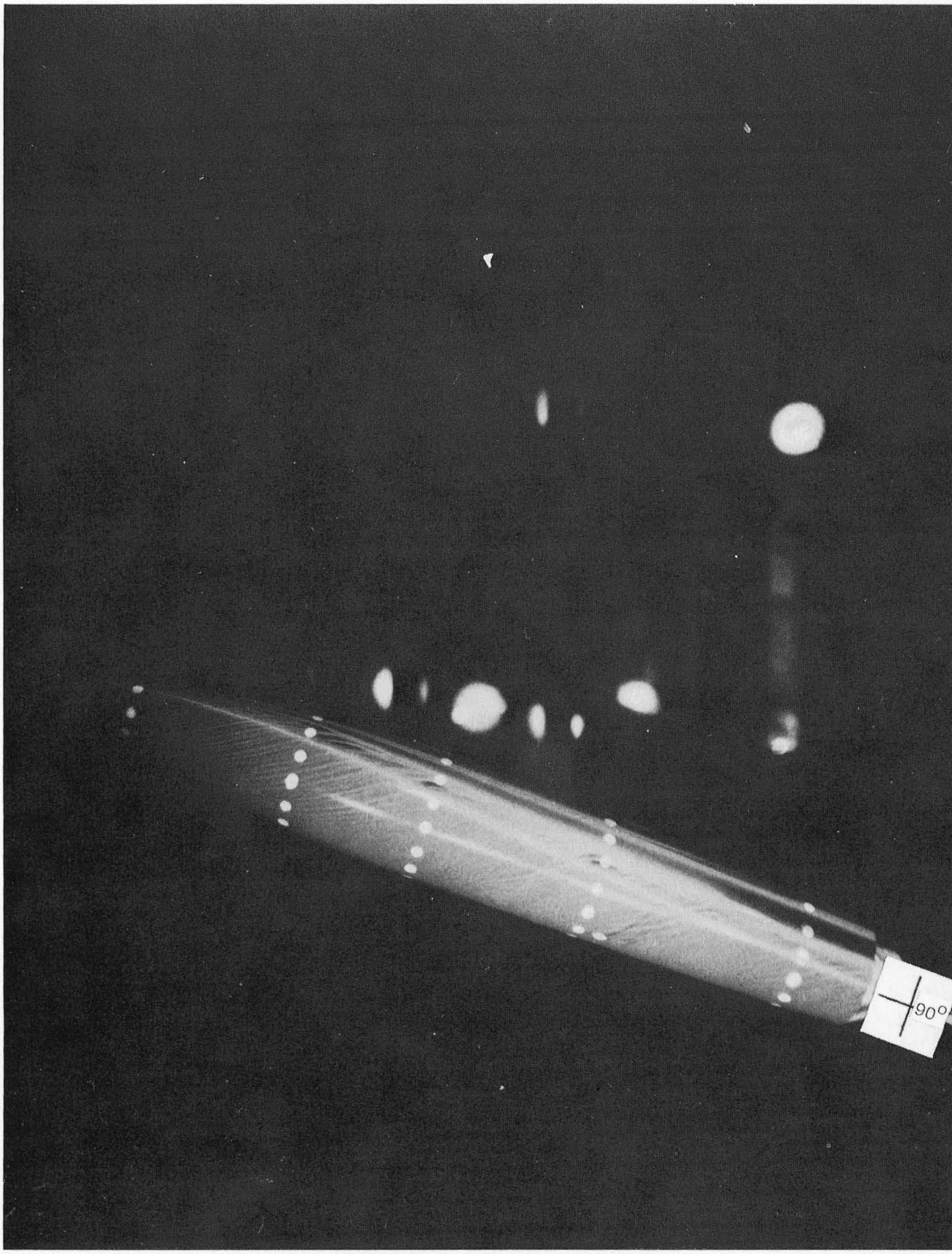
Figure 10.- Continued.



$\alpha = 12^{\circ}$

(c) $M_{\infty} = 2.96$.

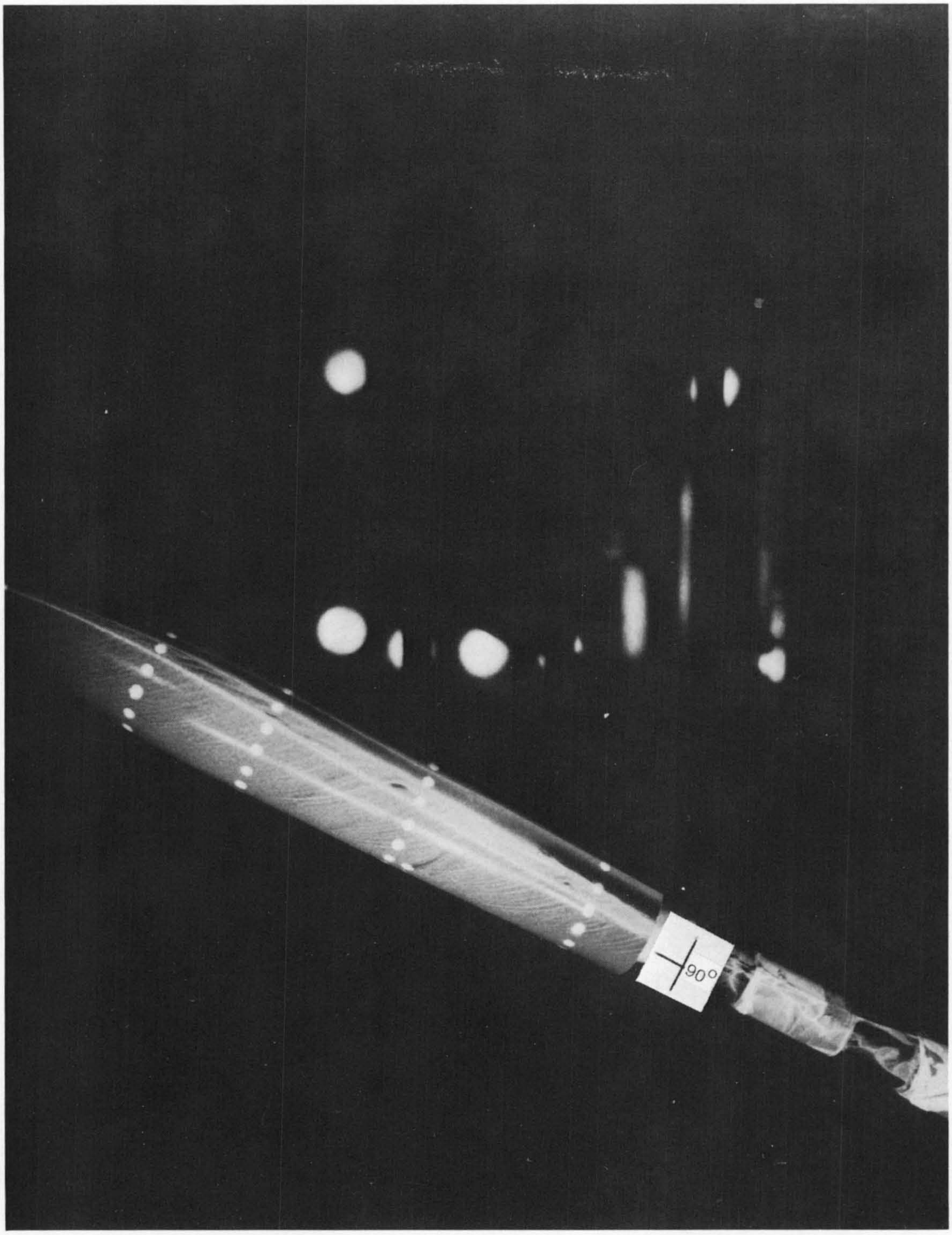
Figure 10.- Continued.



$\alpha = 20^{\circ}$

(c) Continued.

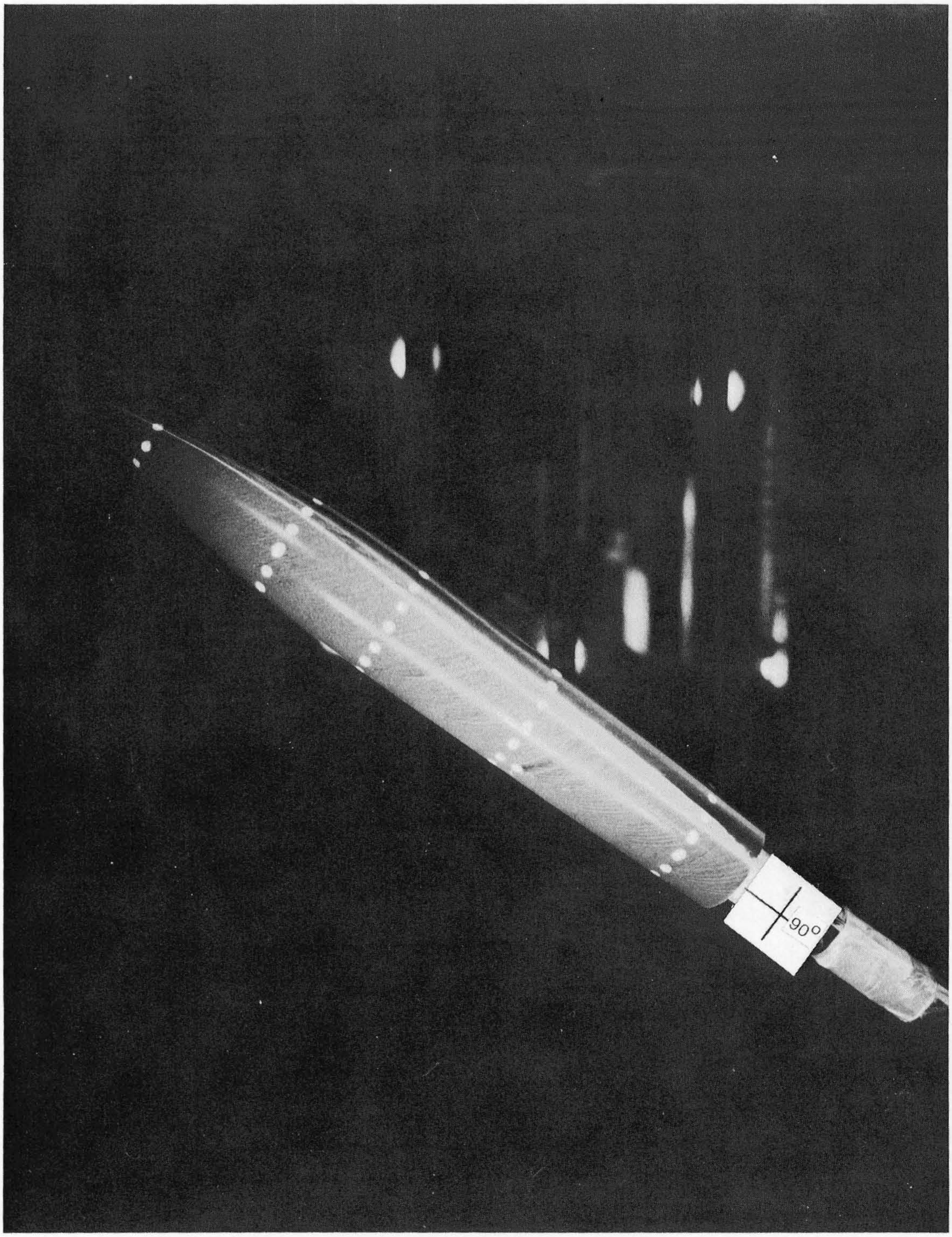
Figure 10.- Continued.



$\alpha = 28^{\circ}$

(c) Continued.

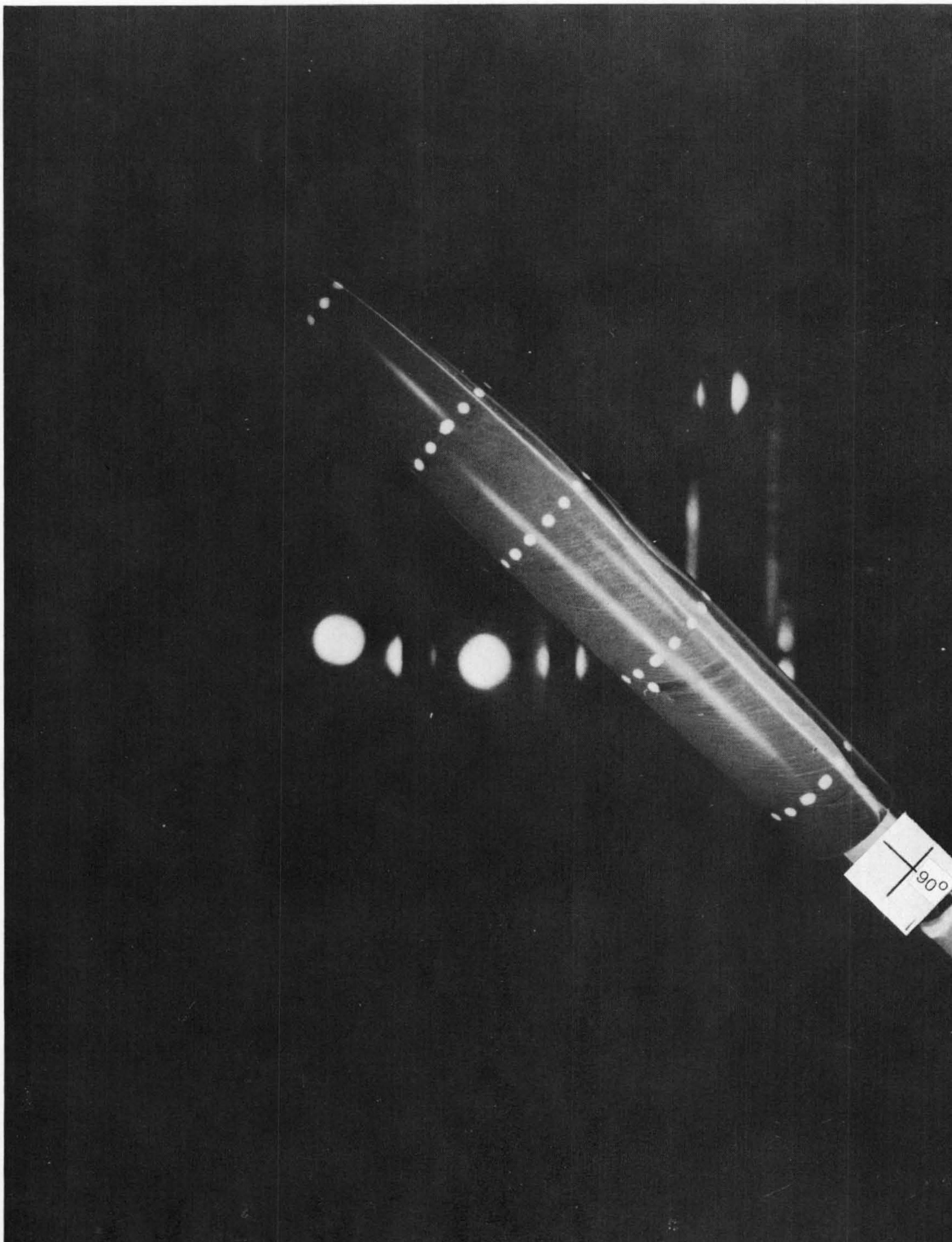
Figure 10.- Continued.



$\alpha = 36^{\circ}$

(c) Continued.

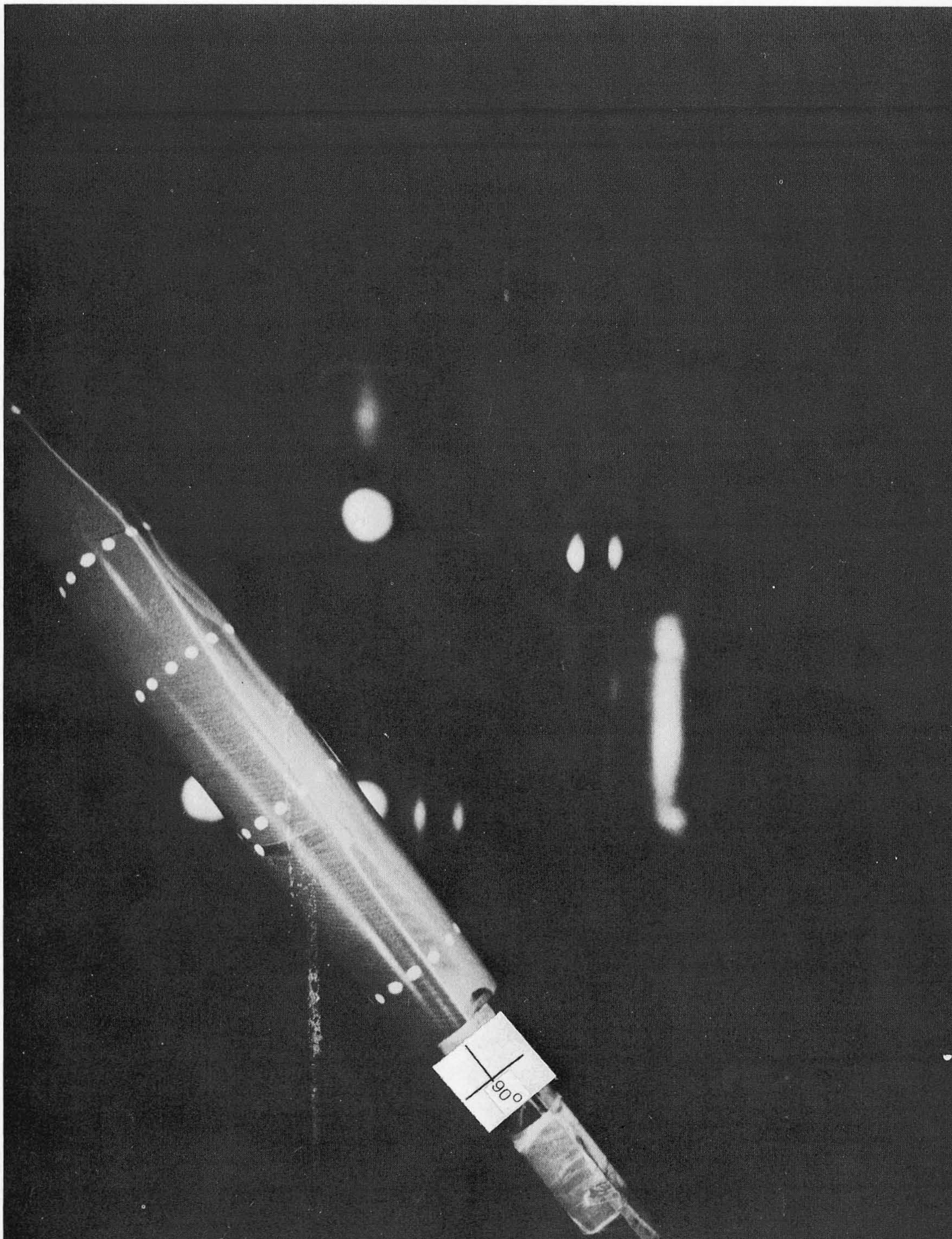
Figure 10.- Continued.



$\alpha = 44^{\circ}$

(c) Continued.

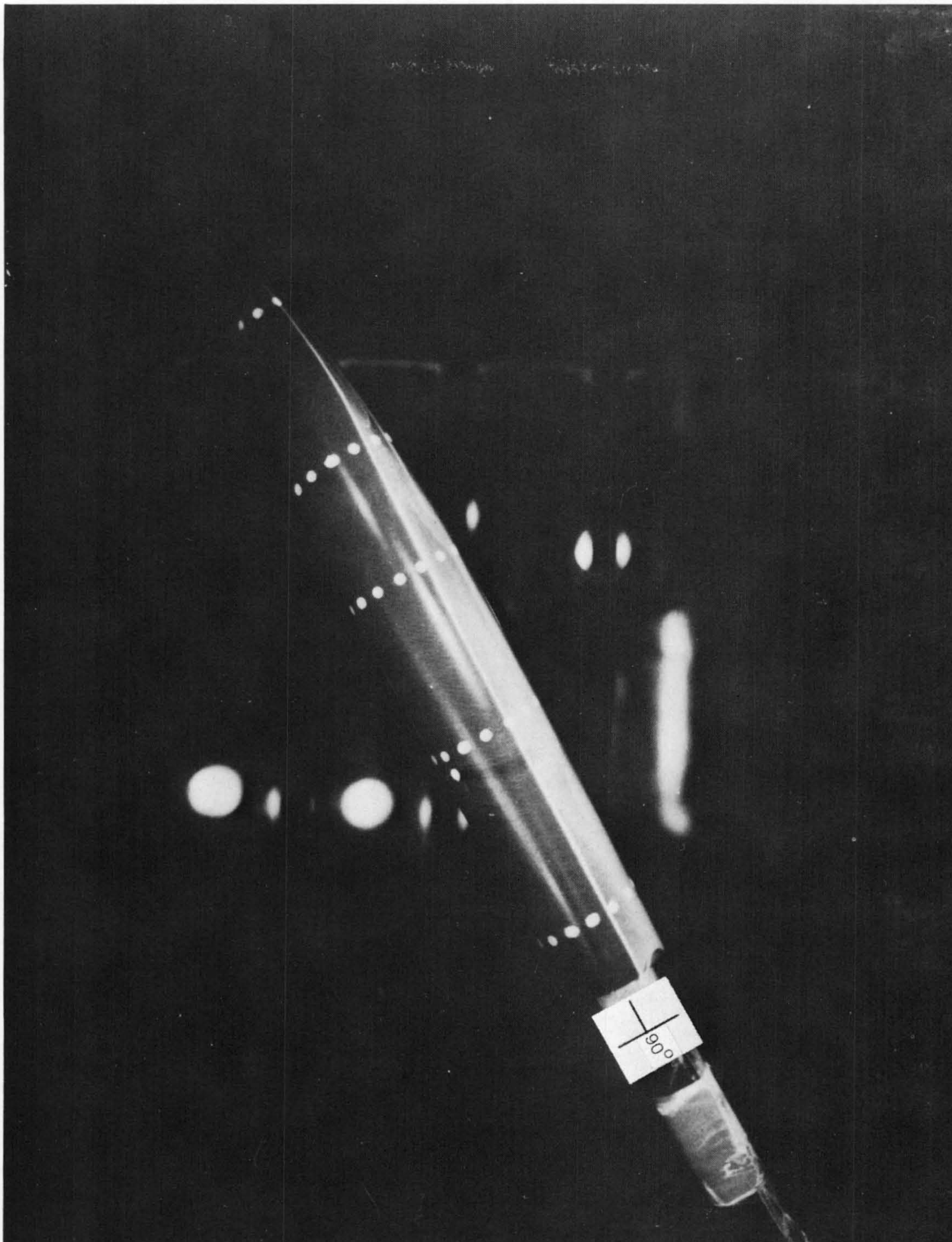
Figure 10.- Continued.



$\alpha = 52^{\circ}$

(c) Continued.

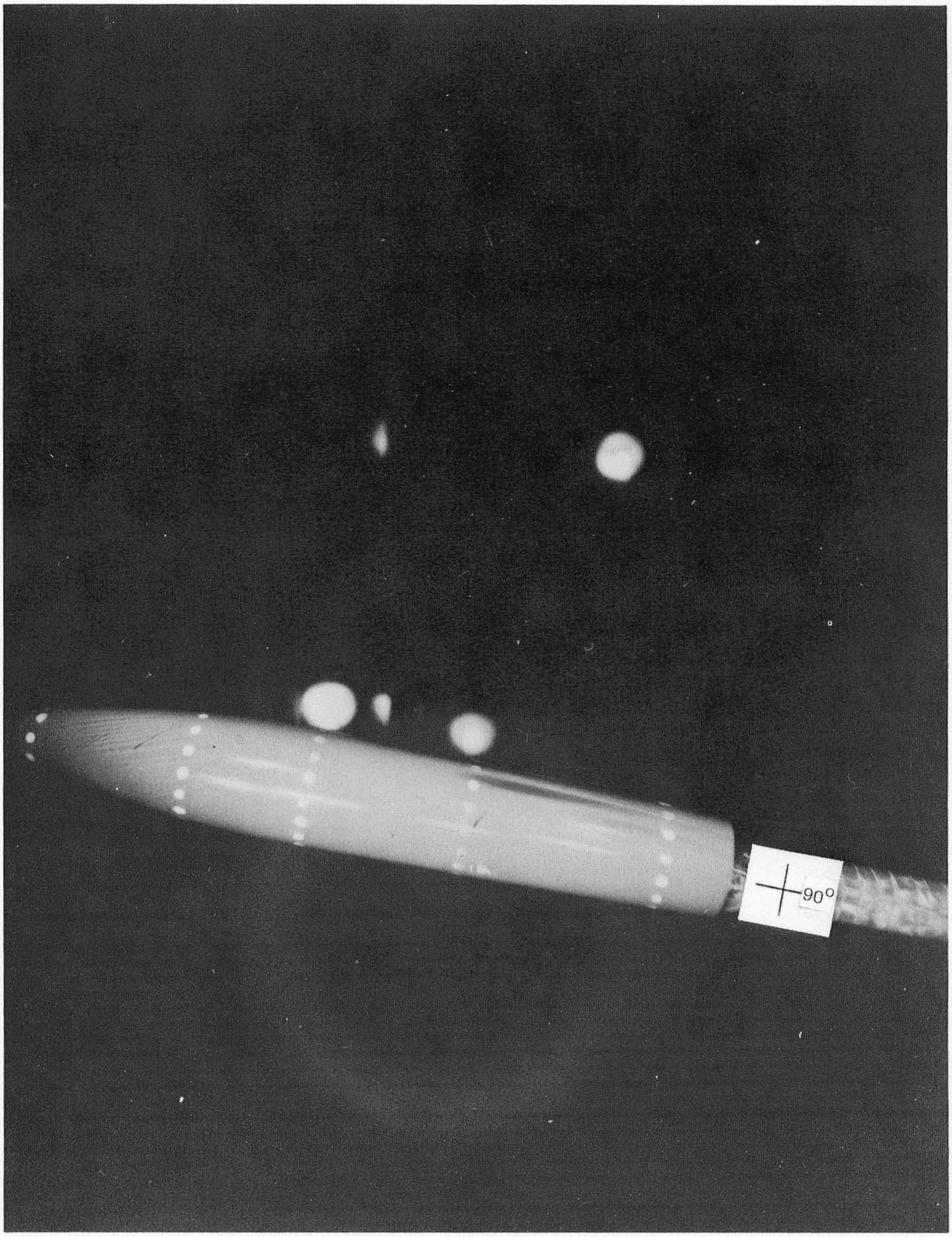
Figure 10.- Continued.



$\alpha = 60^{\circ}$

(c) Concluded.

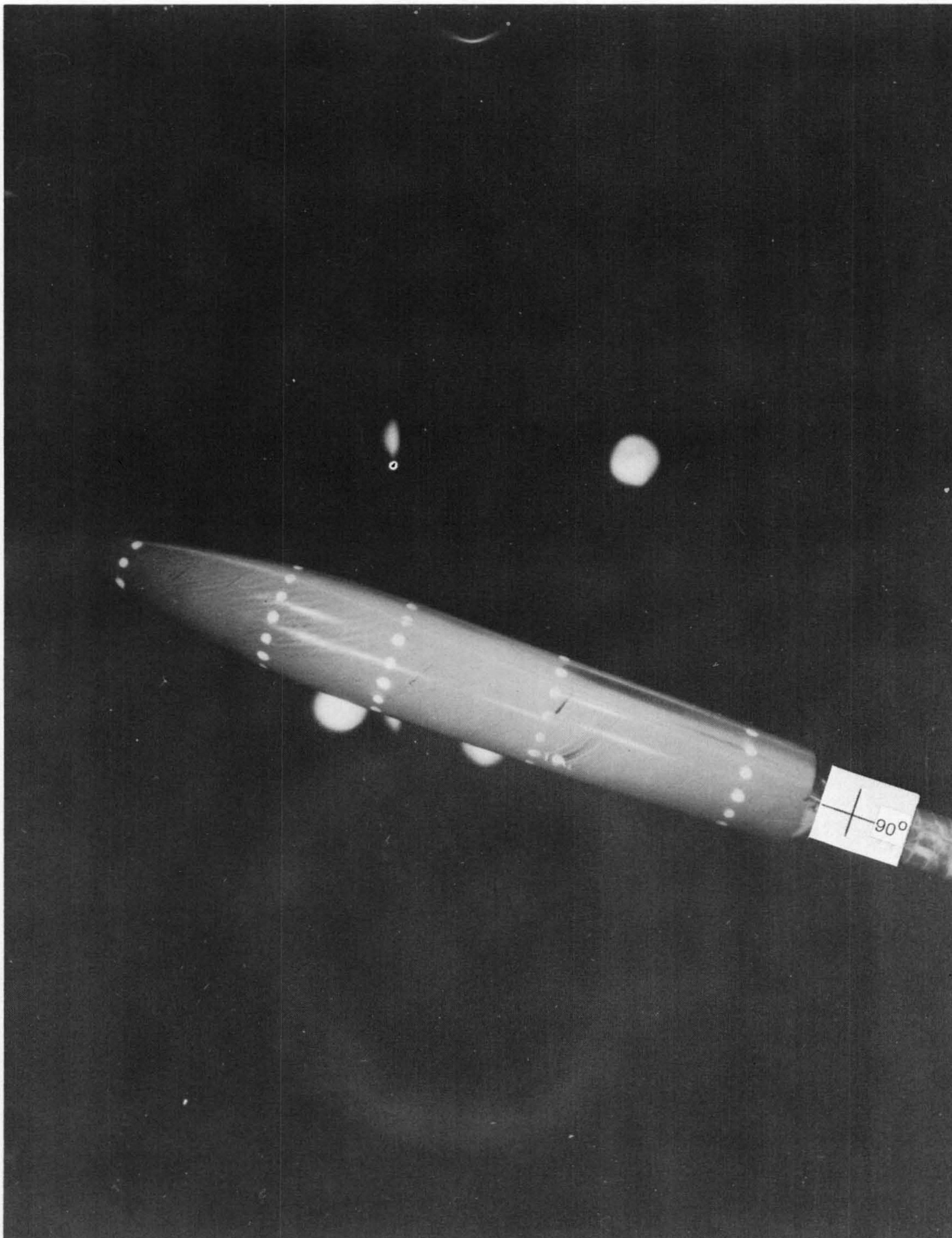
Figure 10.- Continued.



$\alpha = 12^{\circ}$

(d) $M_{\infty} = 4.63$.

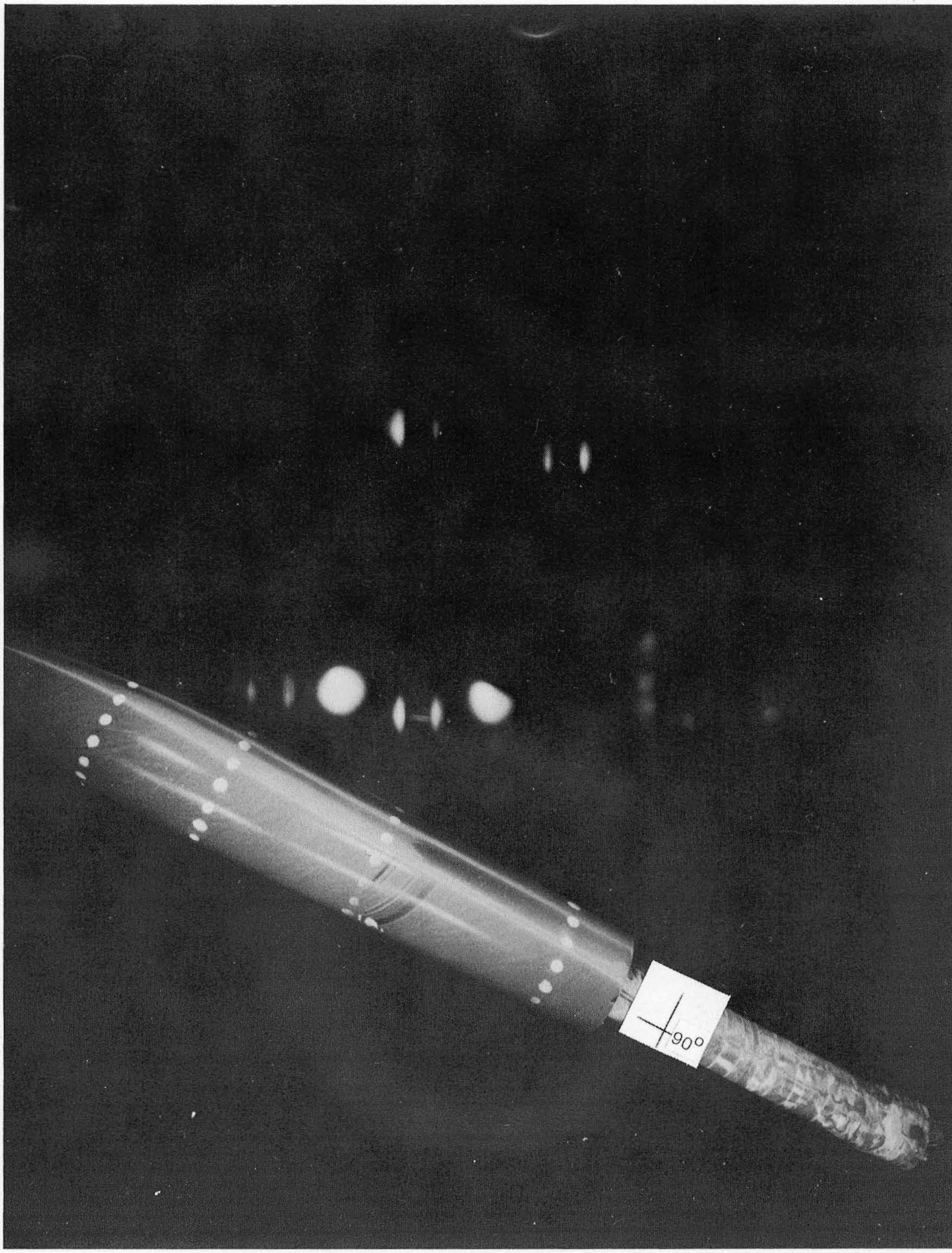
Figure 10.- Continued.



$\alpha = 20^{\circ}$

(d) Continued.

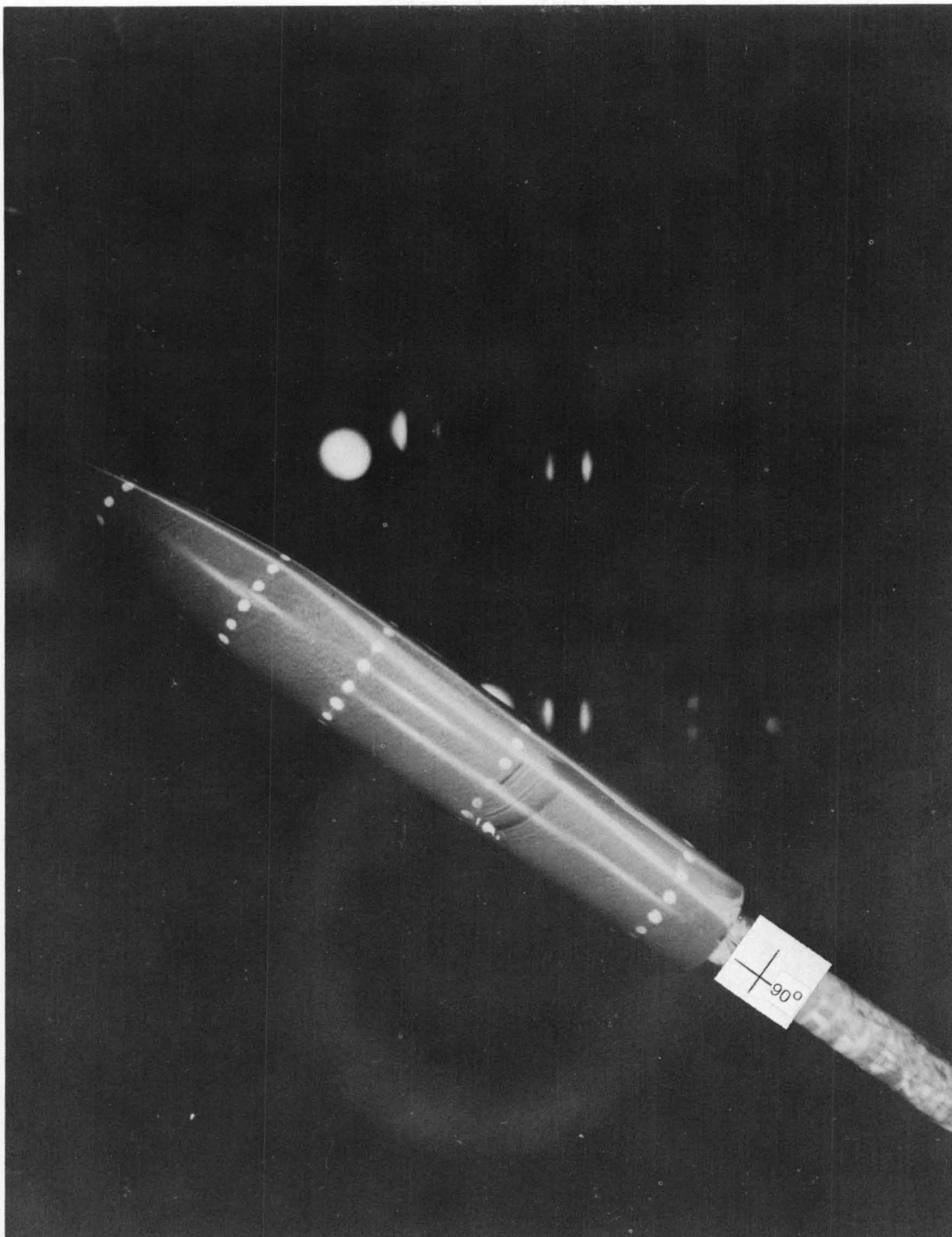
Figure 10.- Continued.



$\alpha = 28^{\circ}$

(d) Continued.

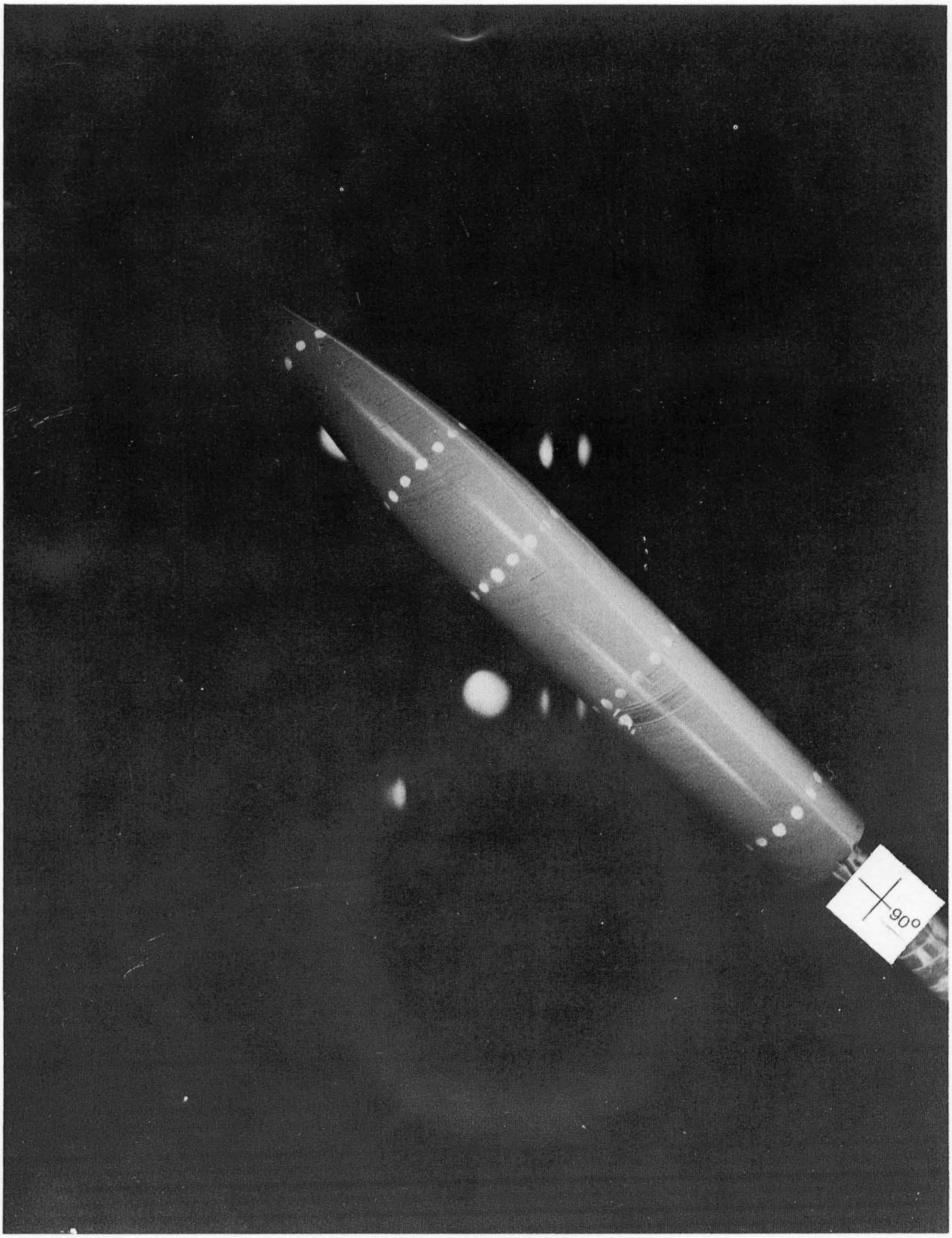
Figure 10.- Continued.



$\alpha = 36^{\circ}$

(d) Continued.

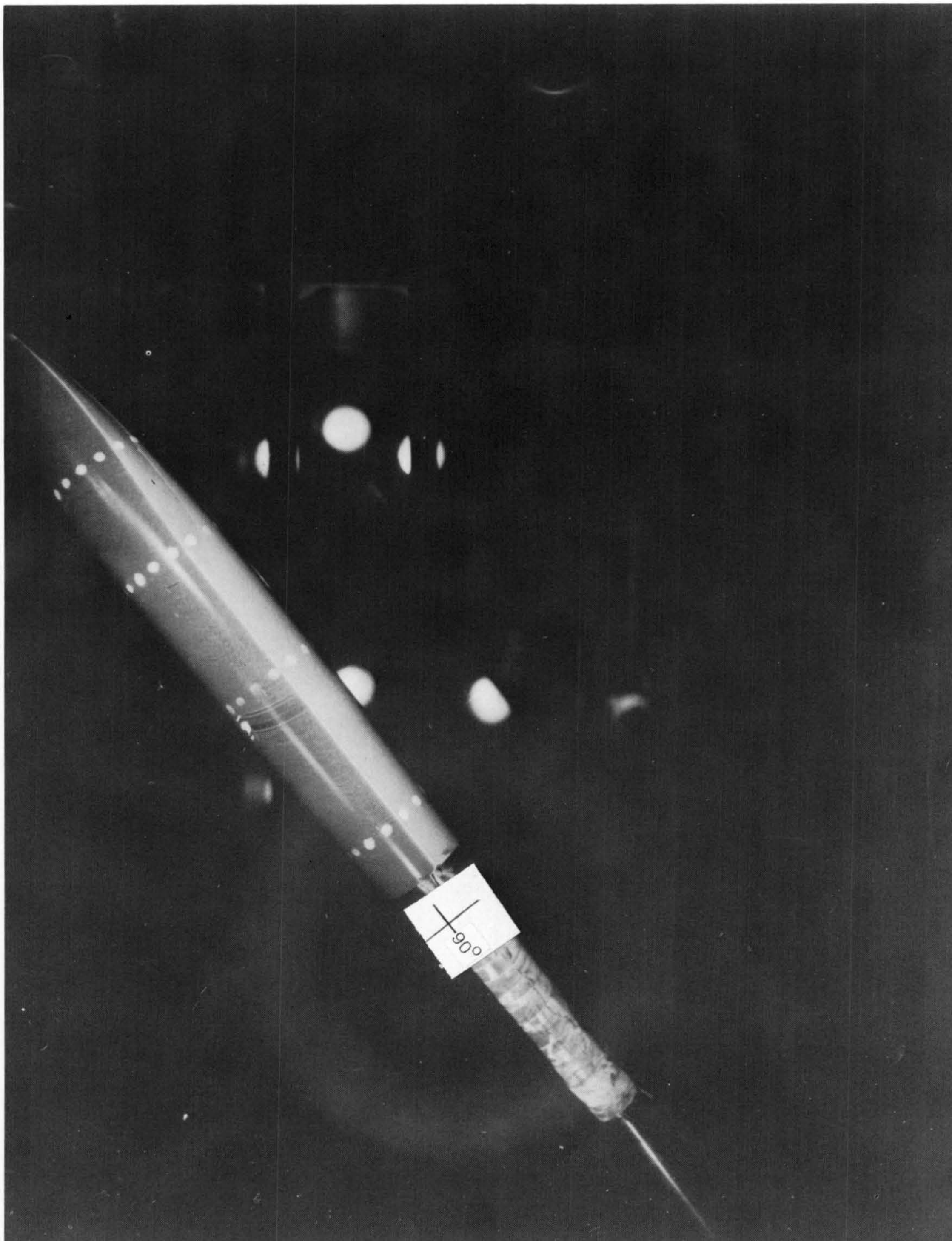
Figure 10.- Continued.



$\alpha = 44^{\circ}$

(d) Continued.

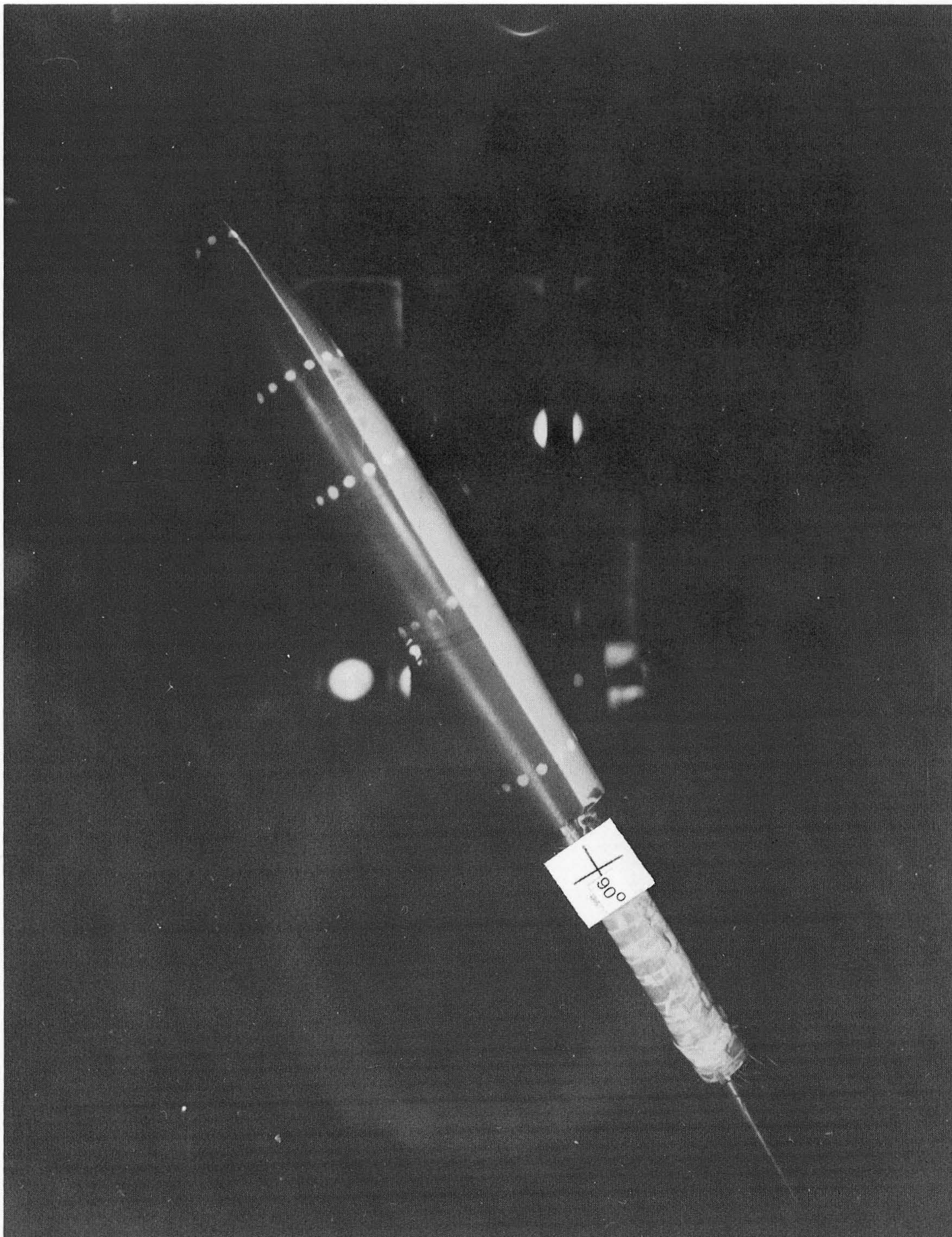
Figure 10.- Continued.



$\alpha = 52^{\circ}$

(d) Continued.

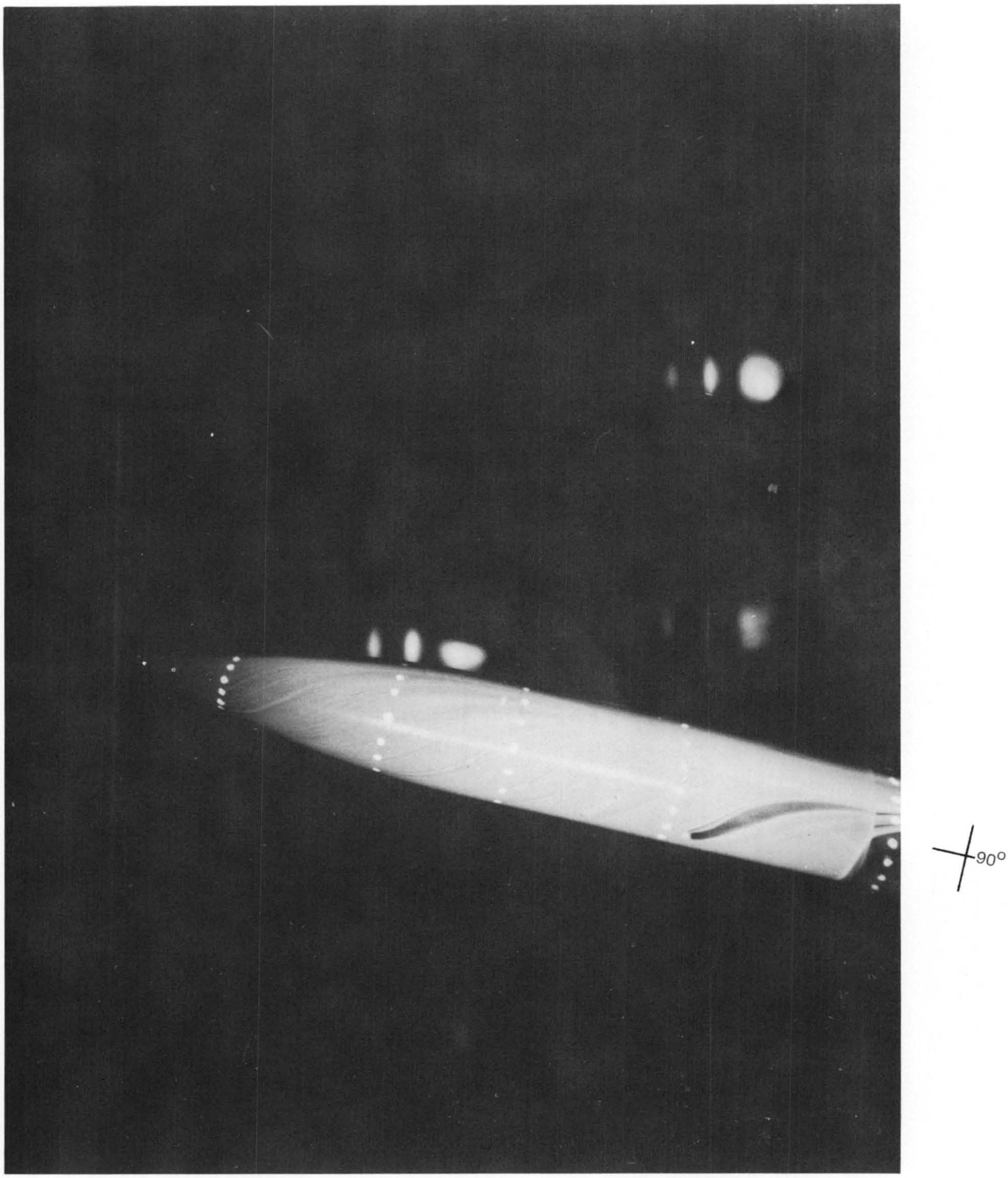
Figure 10.- Continued.



$\alpha = 60^{\circ}$

(d) Concluded.

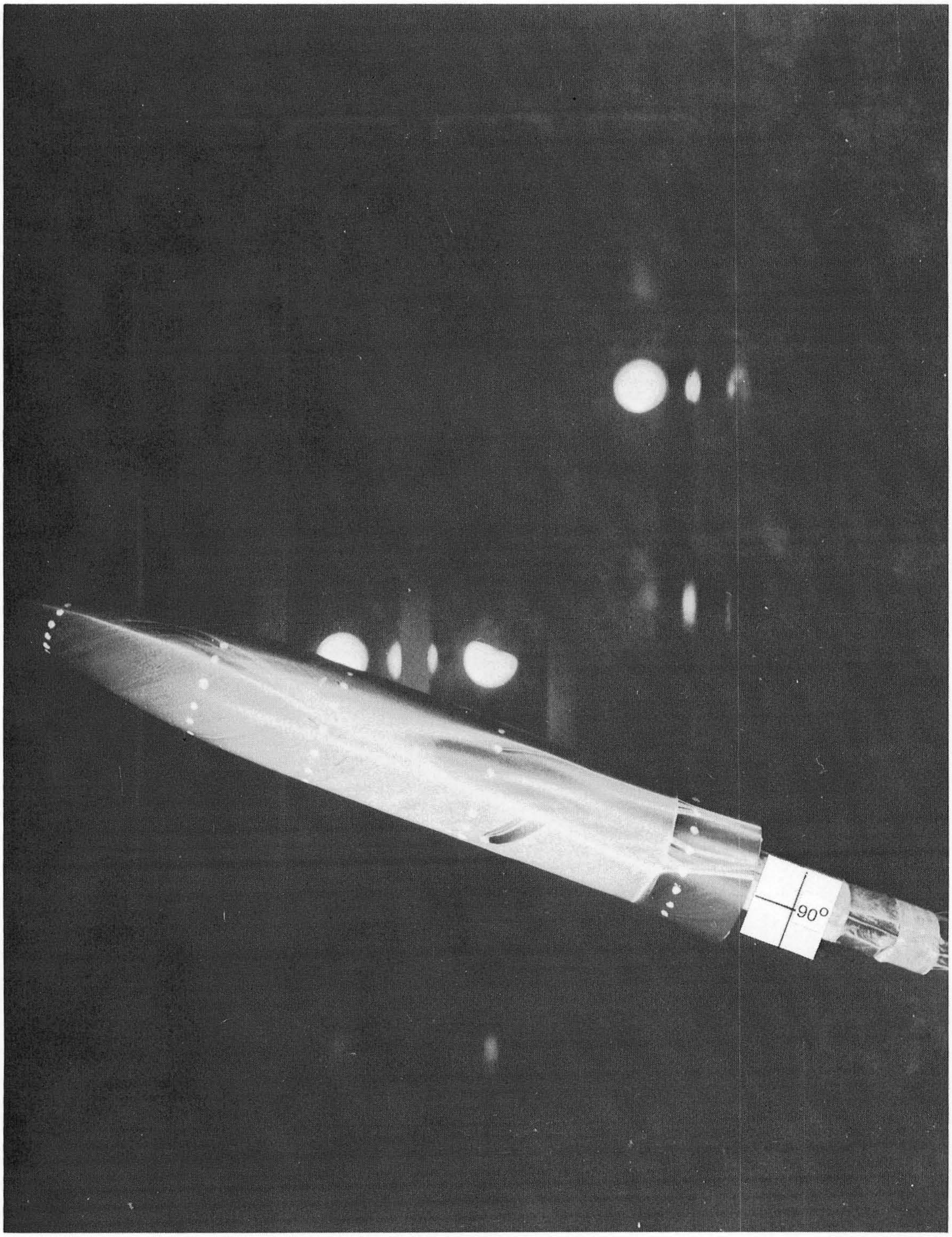
Figure 10.- Concluded.



$\alpha = 12^{\circ}$

(a) $M_{\infty} = 1.6$.

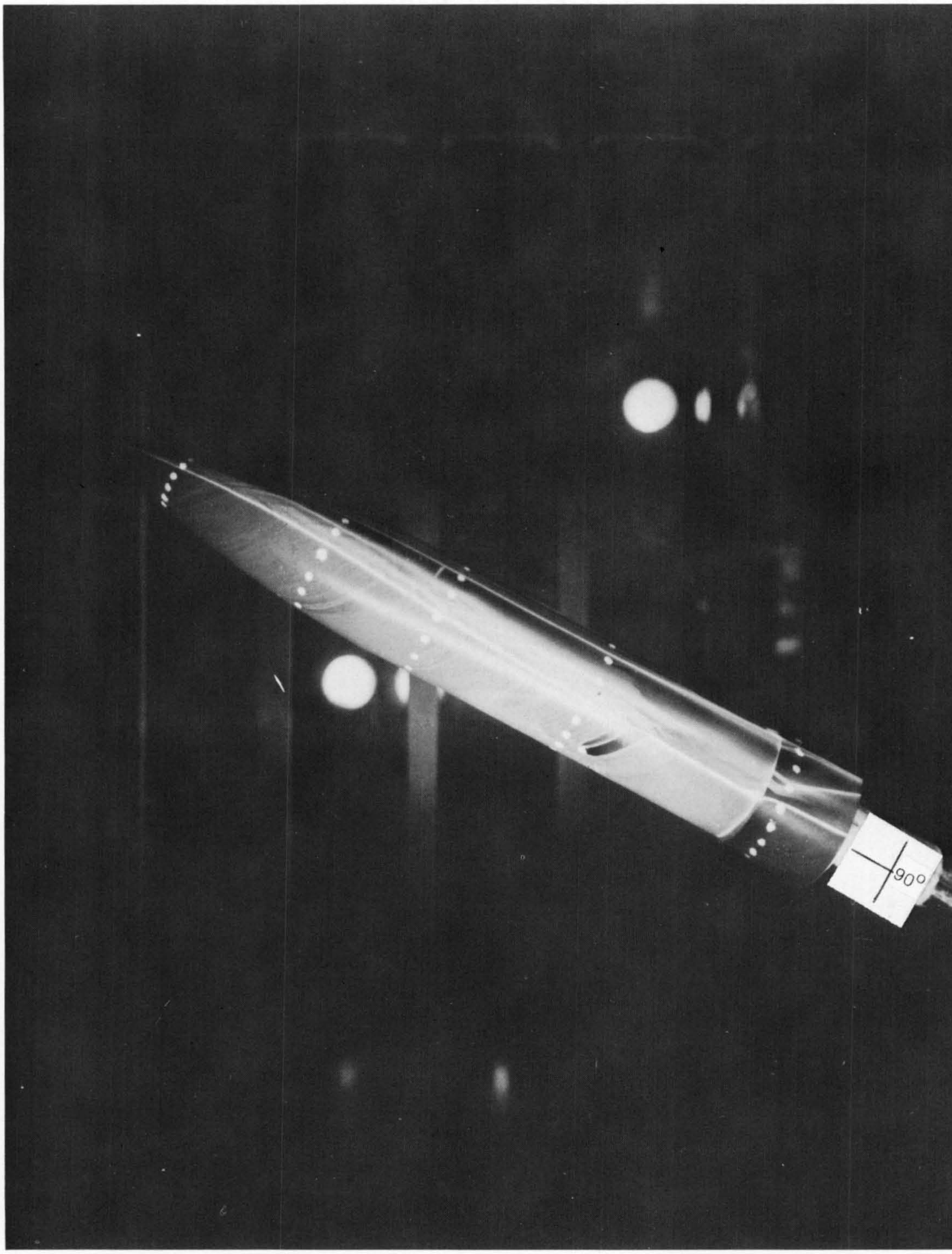
Figure 11.- Oil-flow photographs for circular-arc—cylinder—flare model.



$\alpha = 20^{\circ}$

(a) Continued.

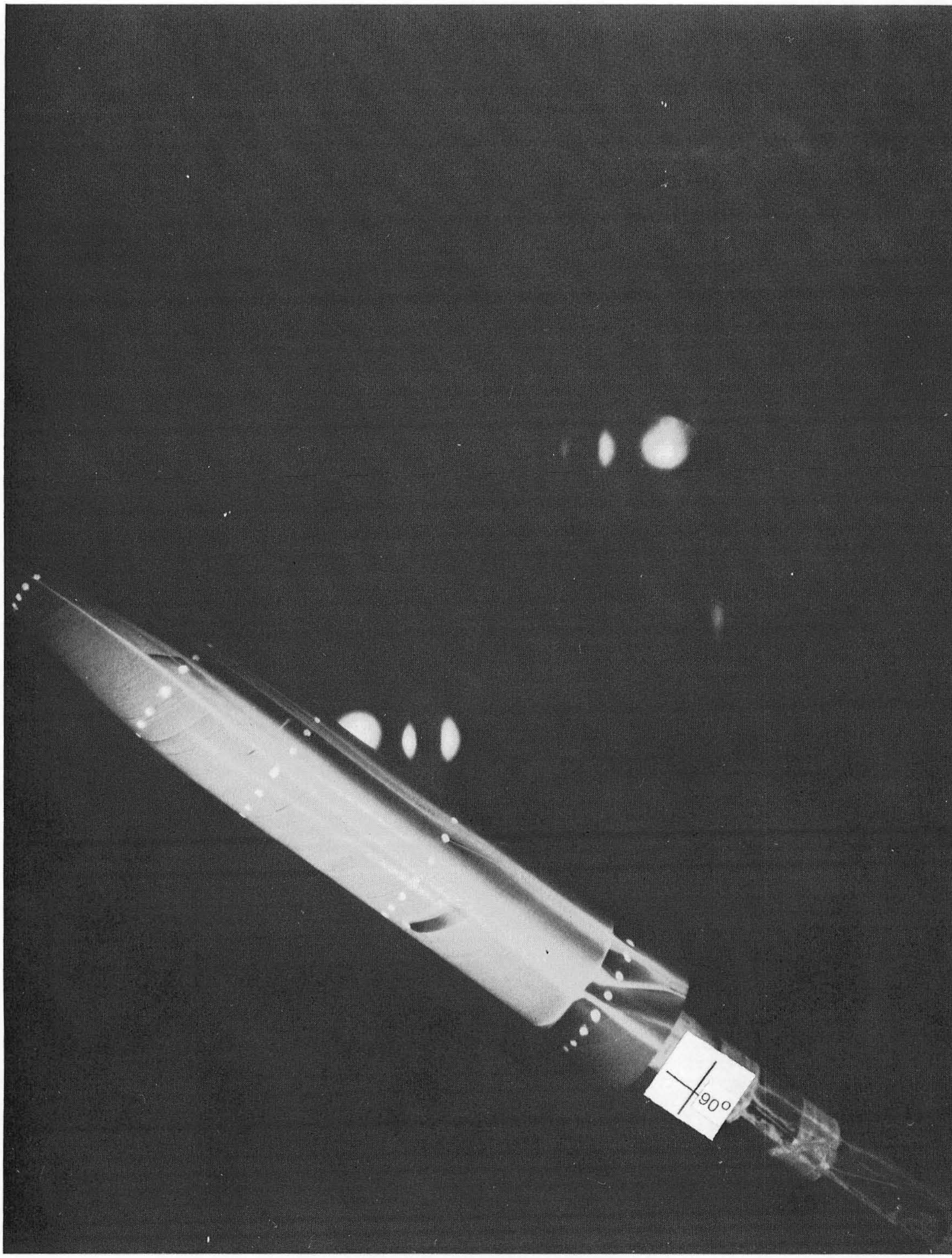
Figure 11.- Continued.



$\alpha = 28^{\circ}$

(a) Continued.

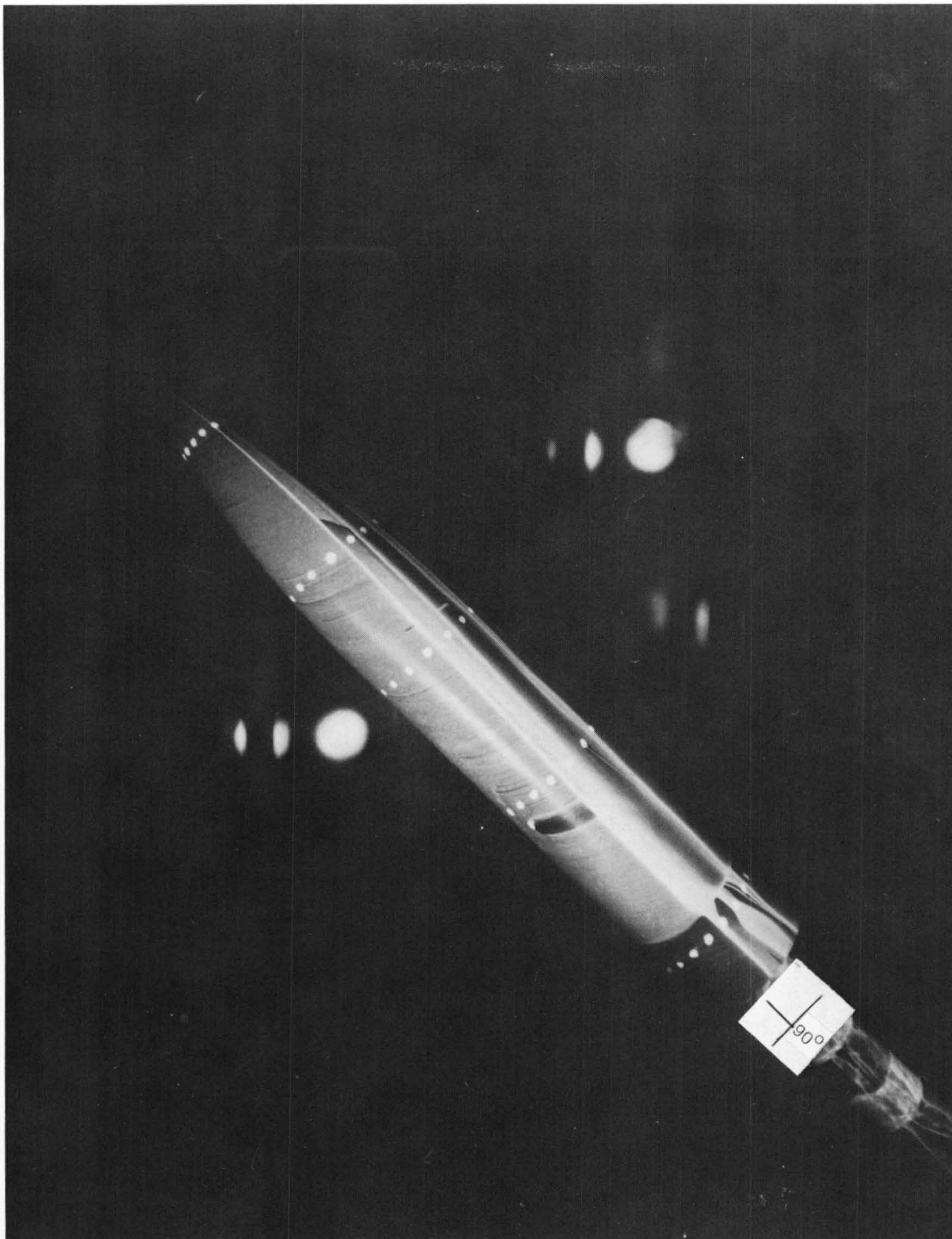
Figure 11.- Continued.



$\alpha = 36^{\circ}$

(a) Continued.

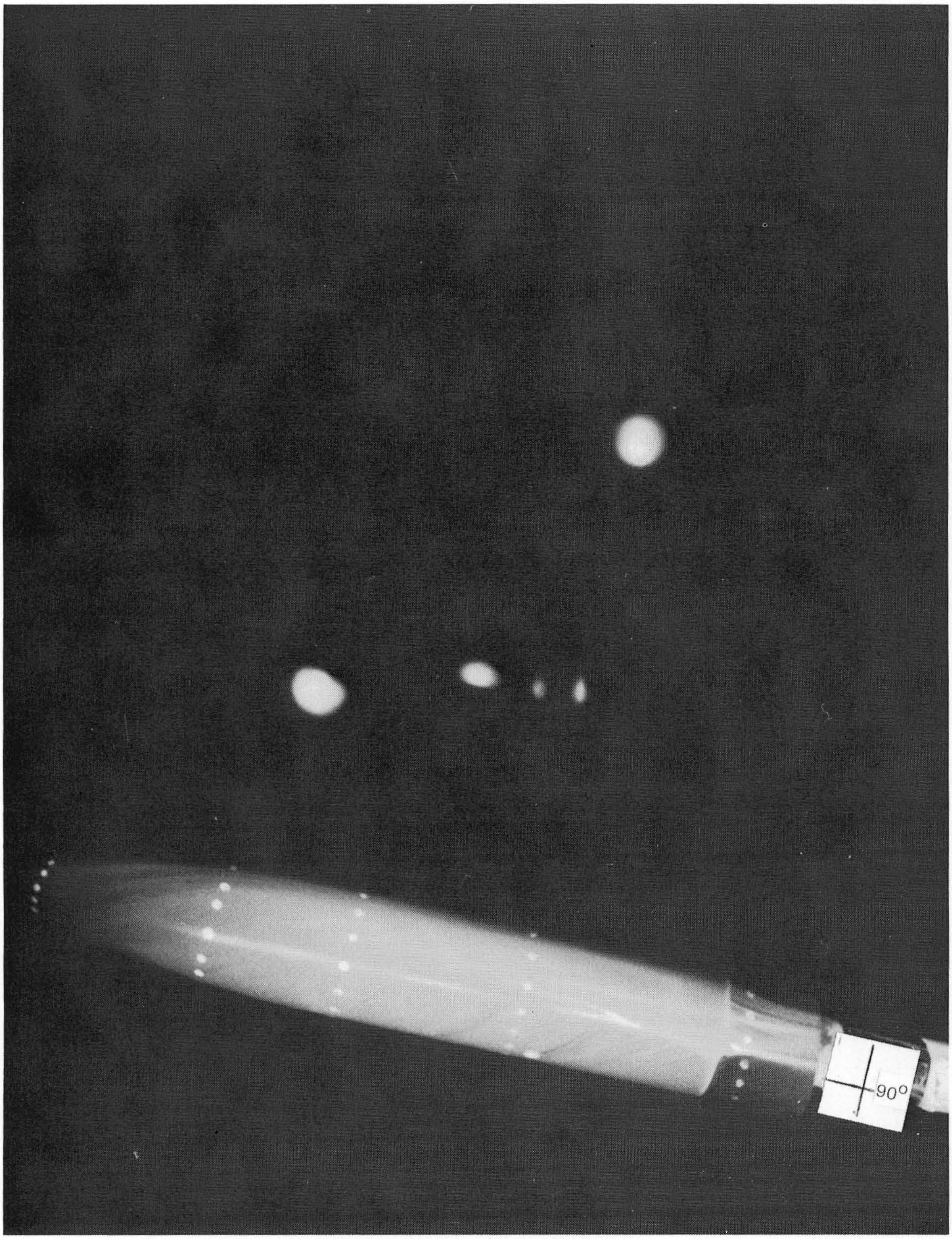
Figure 11.- Continued.



$\alpha = 44^{\circ}$

(a) Concluded.

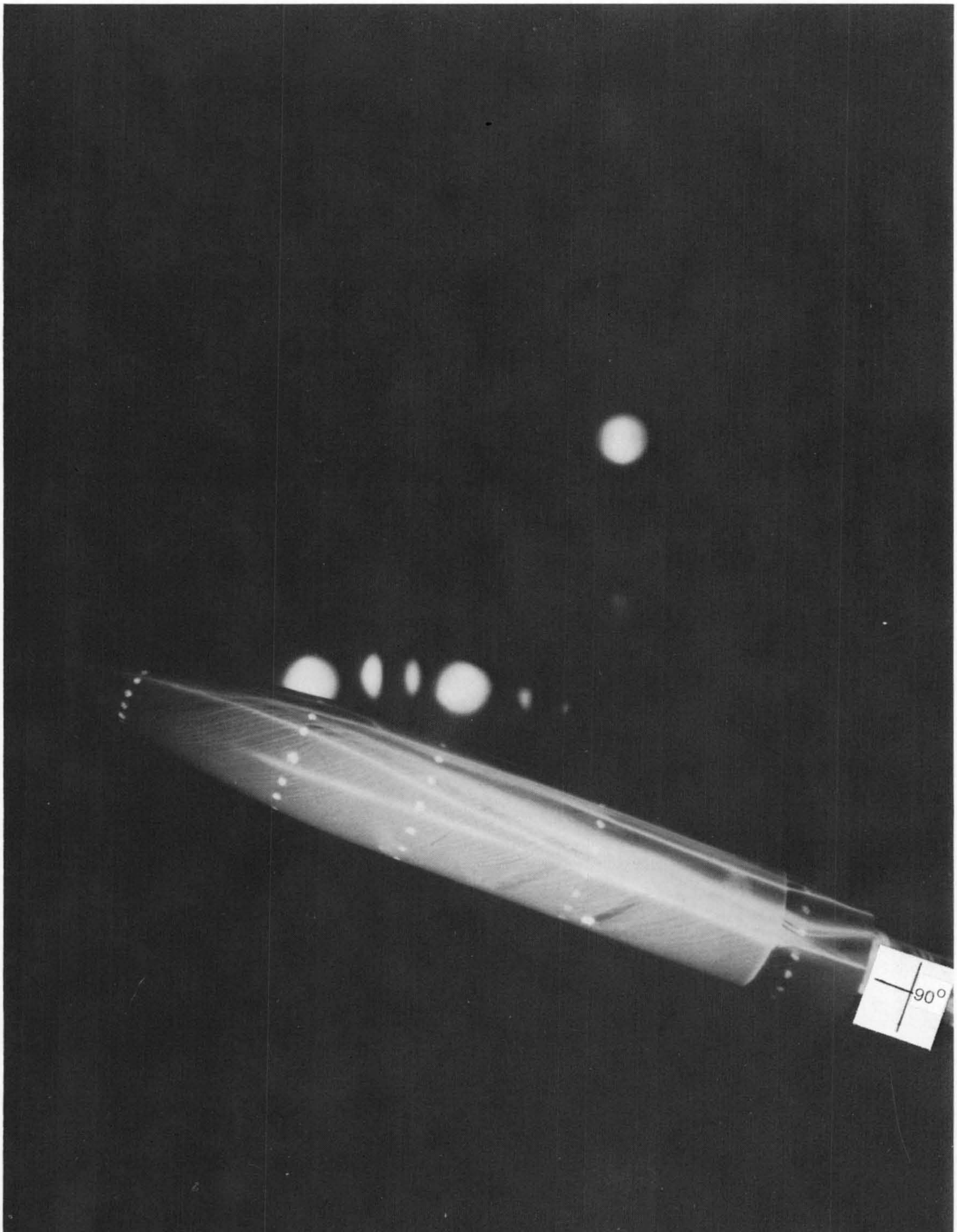
Figure 11.- Continued.



$\alpha = 12^{\circ}$

(b) $M_{\infty} = 2.3$.

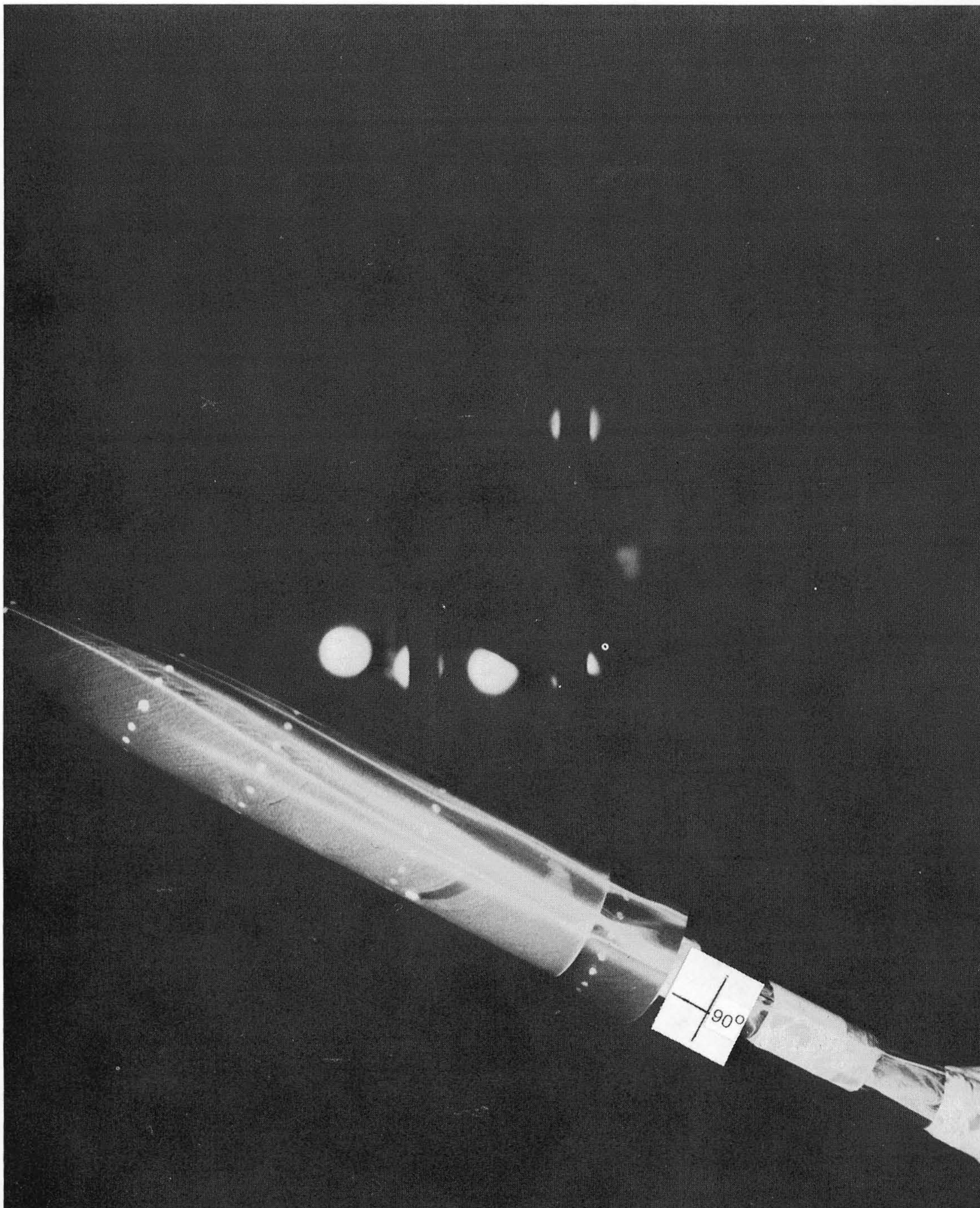
Figure 11.- Continued.



$\alpha = 20^{\circ}$

(b) Continued.

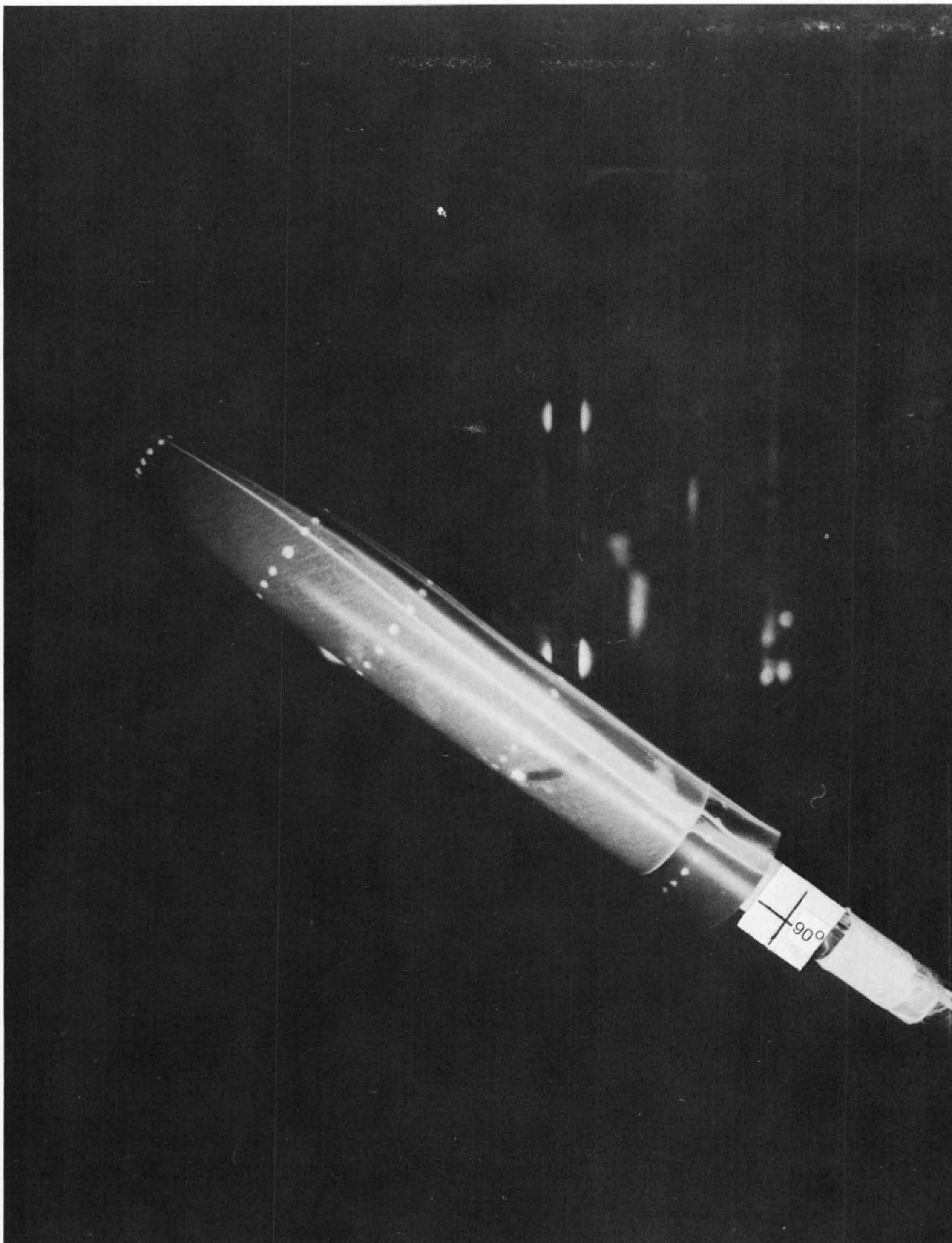
Figure 11.- Continued.



$\alpha = 28^{\circ}$

(b) Continued.

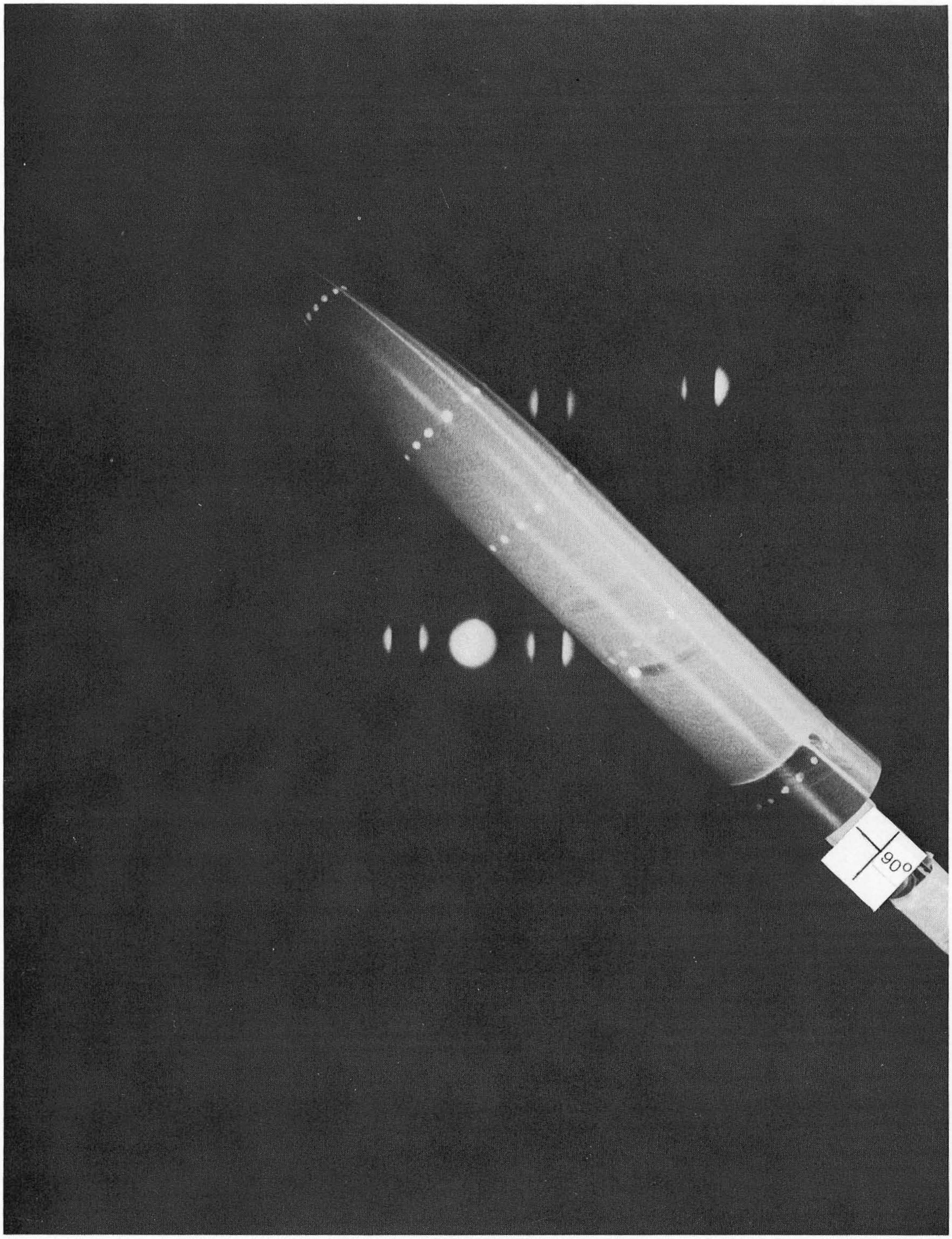
Figure 11.- Continued.



$\alpha = 36^{\circ}$

(b) Continued.

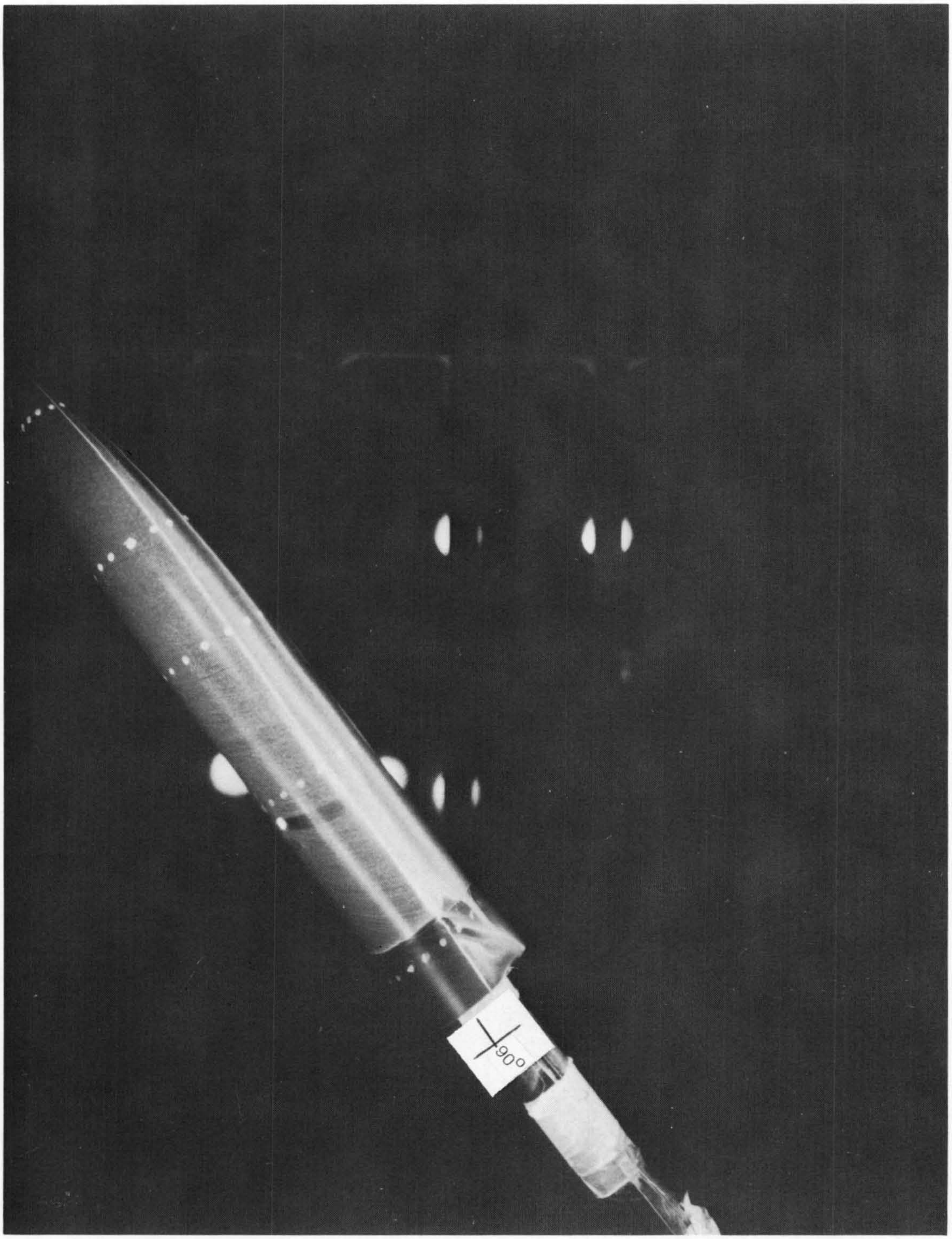
Figure 11.- Continued.



$\alpha = 44^{\circ}$

(b) Continued.

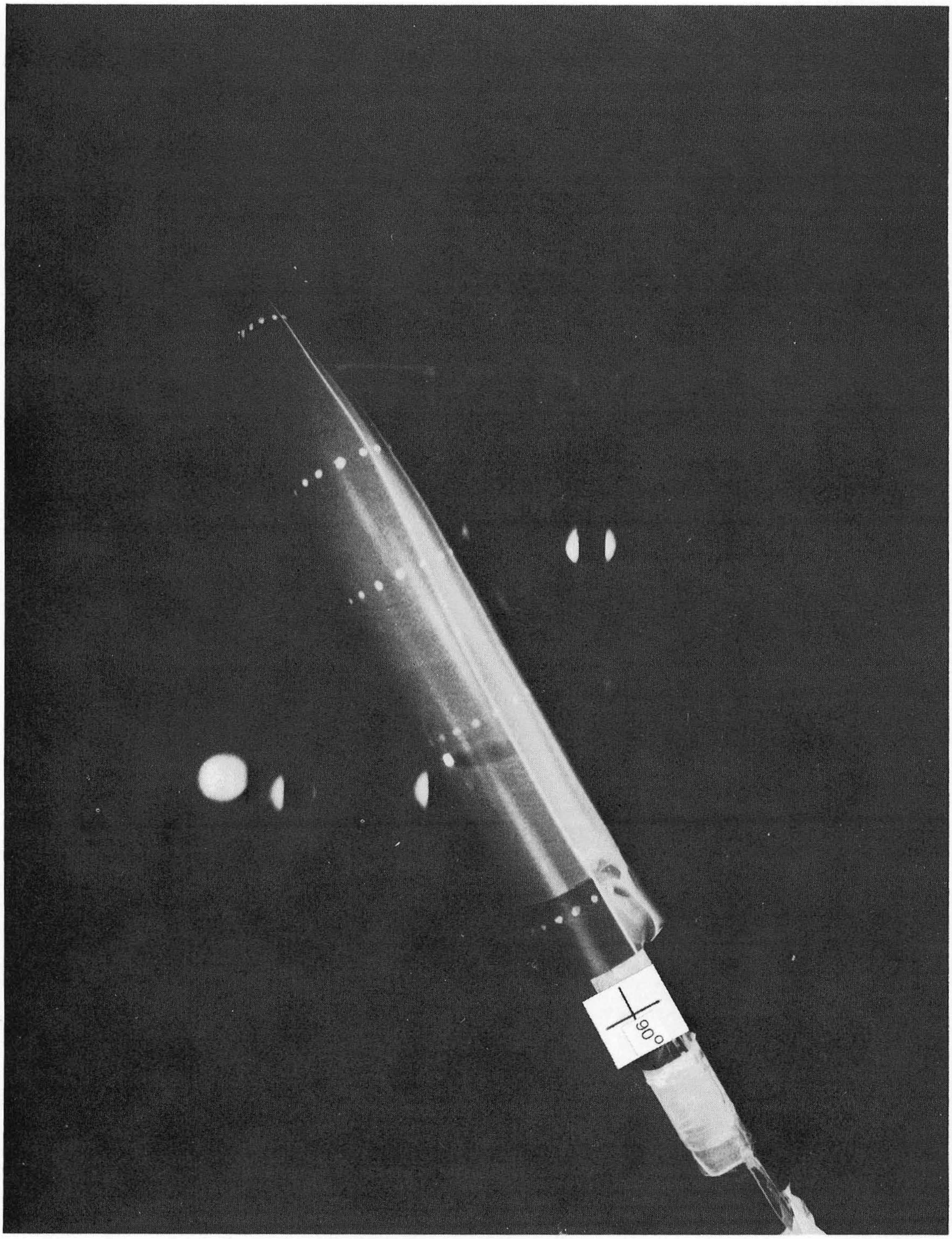
Figure 11.- Continued.



$\alpha = 52^{\circ}$

(b) Continued.

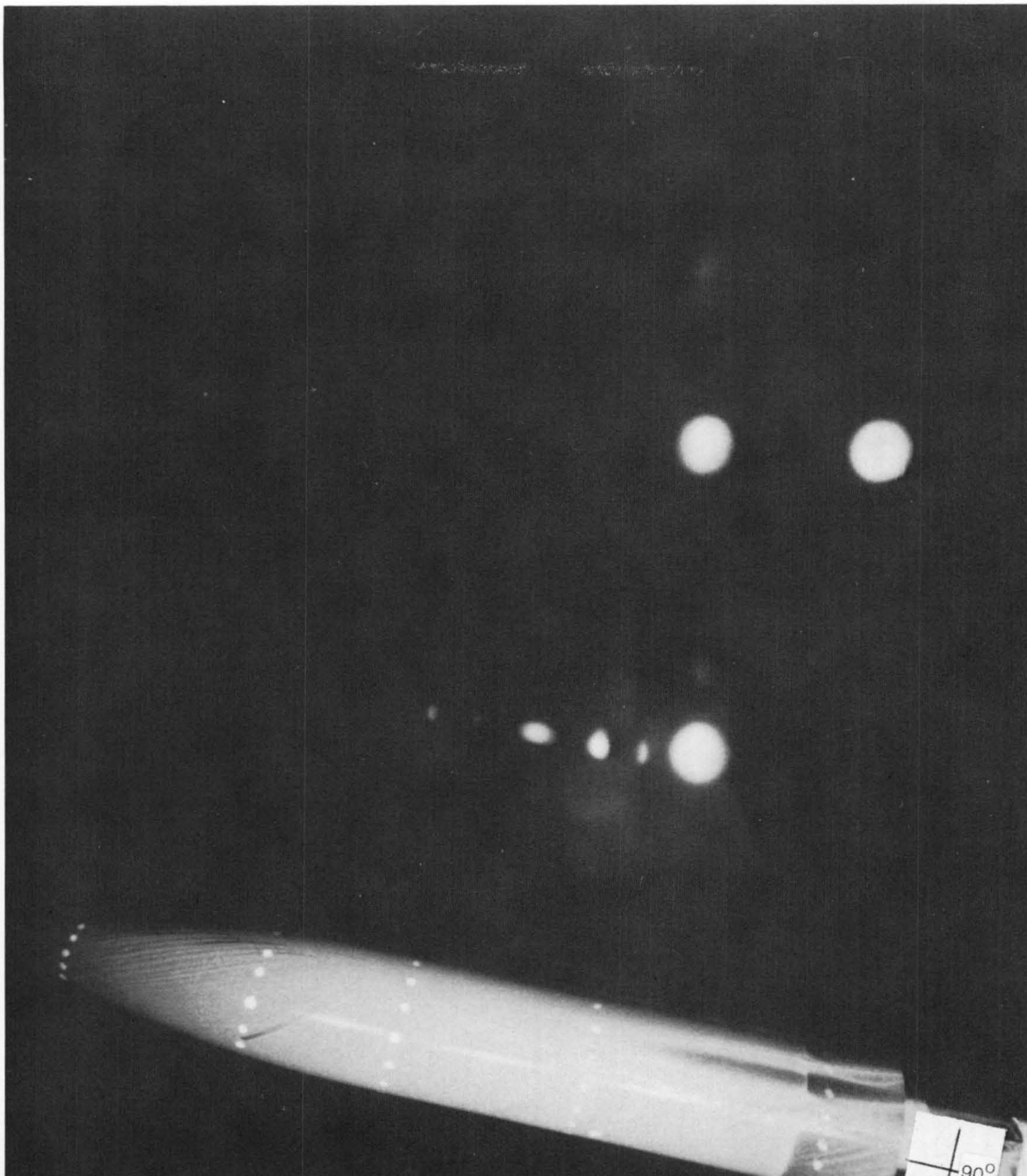
Figure 11.- Continued.



$\alpha = 60^{\circ}$

(b) Concluded.

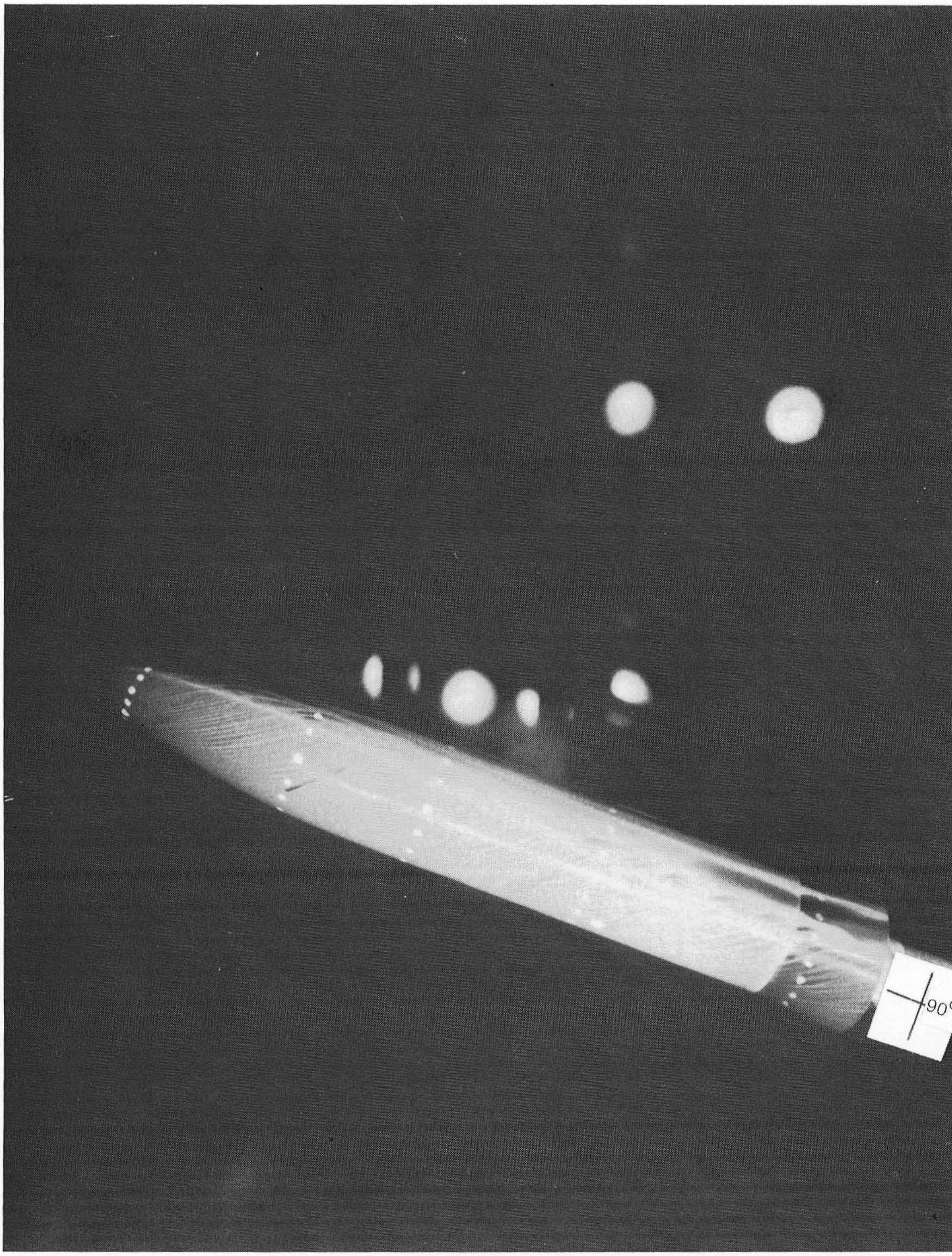
Figure 11.- Continued.



$\alpha = 12^{\circ}$

(c) $M_{\infty} = 2.96$.

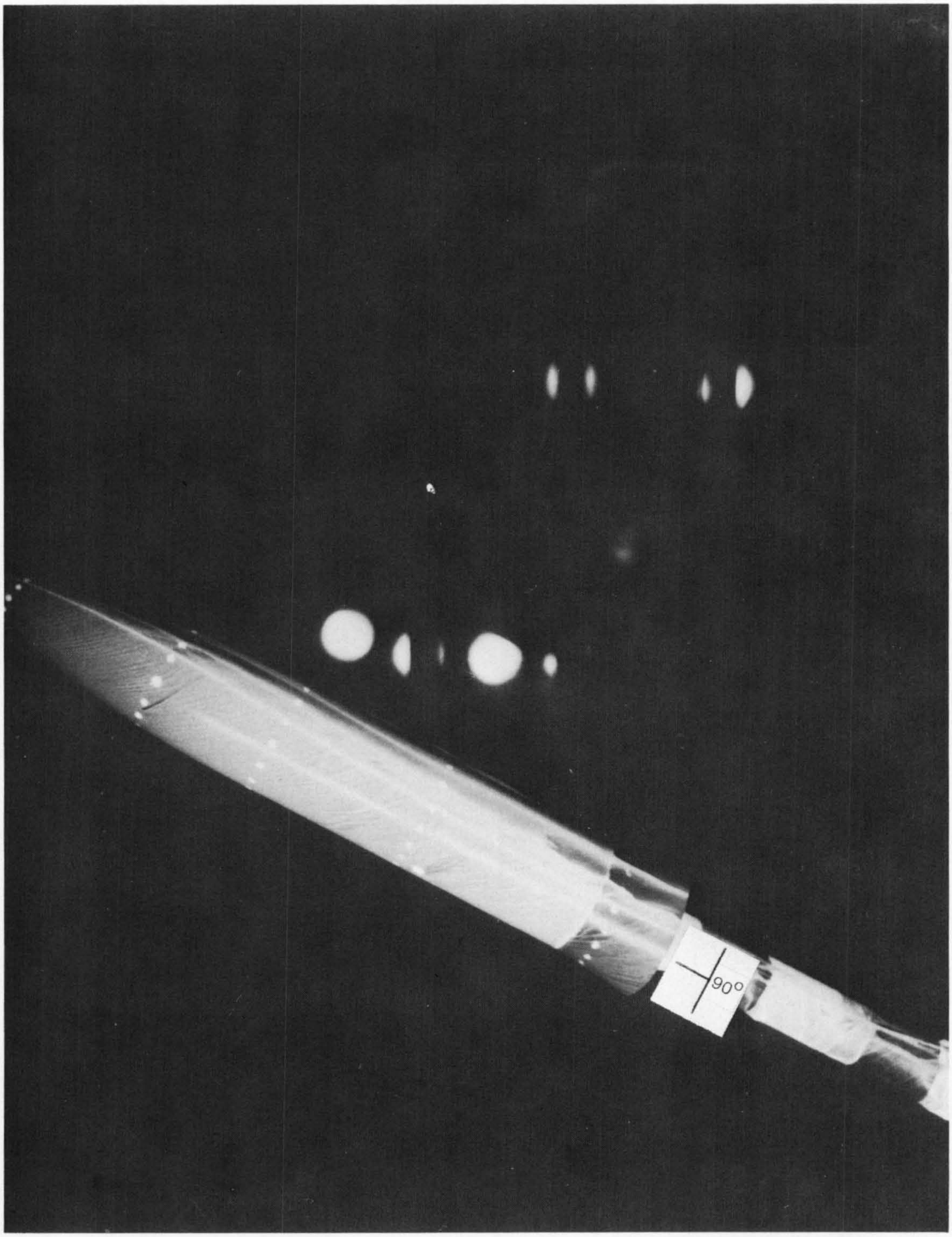
Figure 11.- Continued.



$\alpha = 20^{o}$

(c) Continued.

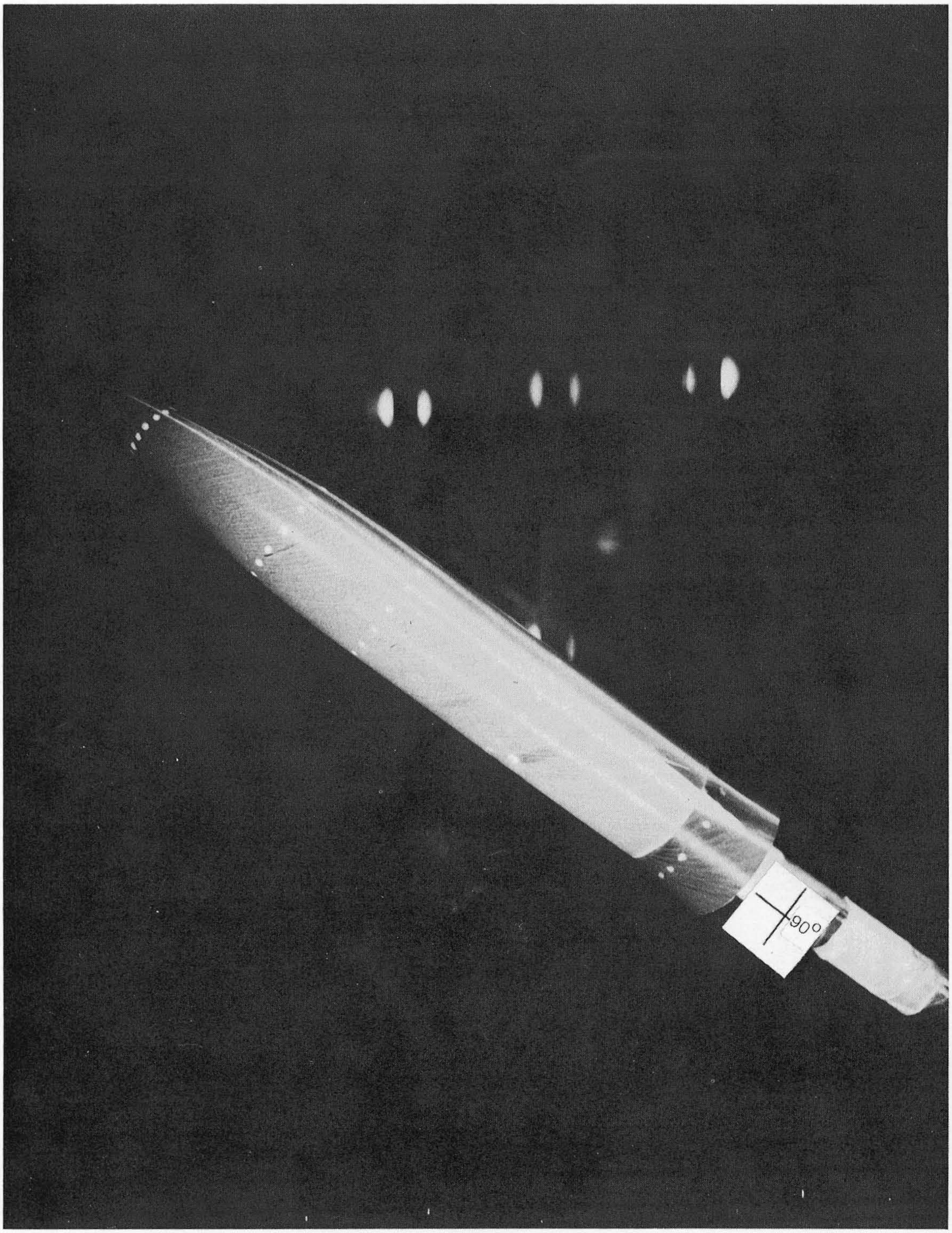
Figure 11.- Continued.



$\alpha = 28^{\circ}$

(c) Continued.

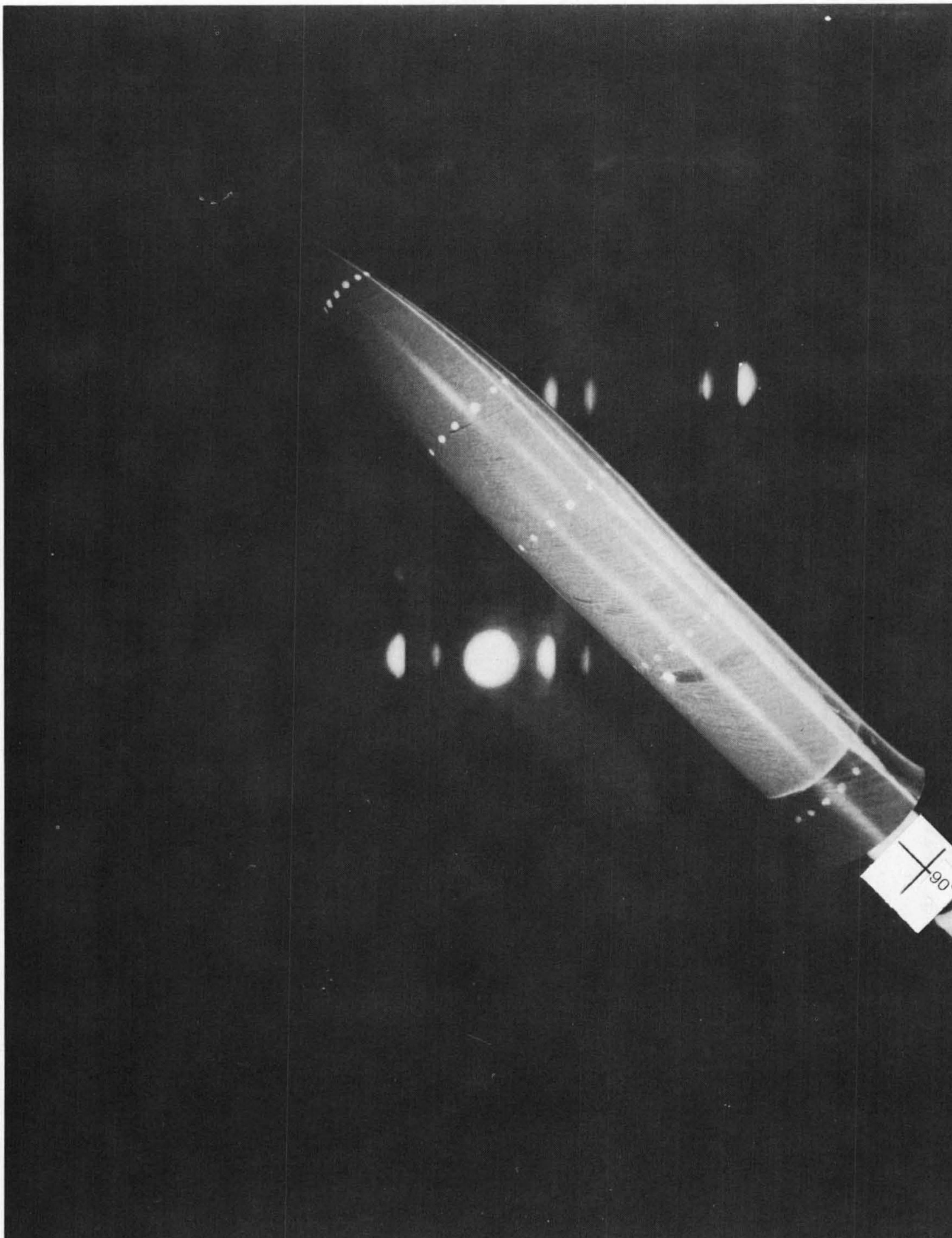
Figure 11.- Continued.



$\alpha = 36^{\circ}$

(c) Continued.

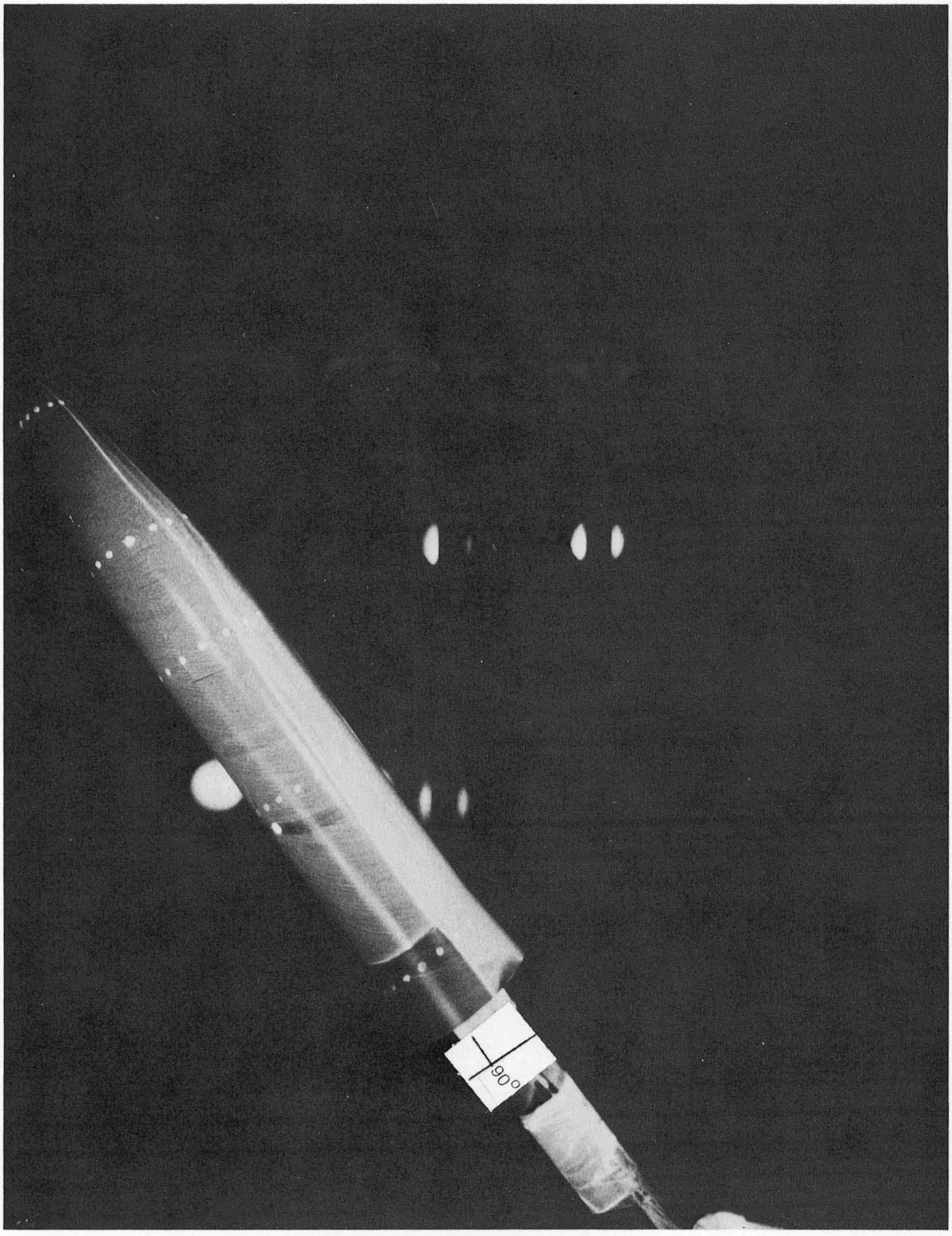
Figure 11.- Continued.



$\alpha = 44^{\circ}$

(c) Continued.

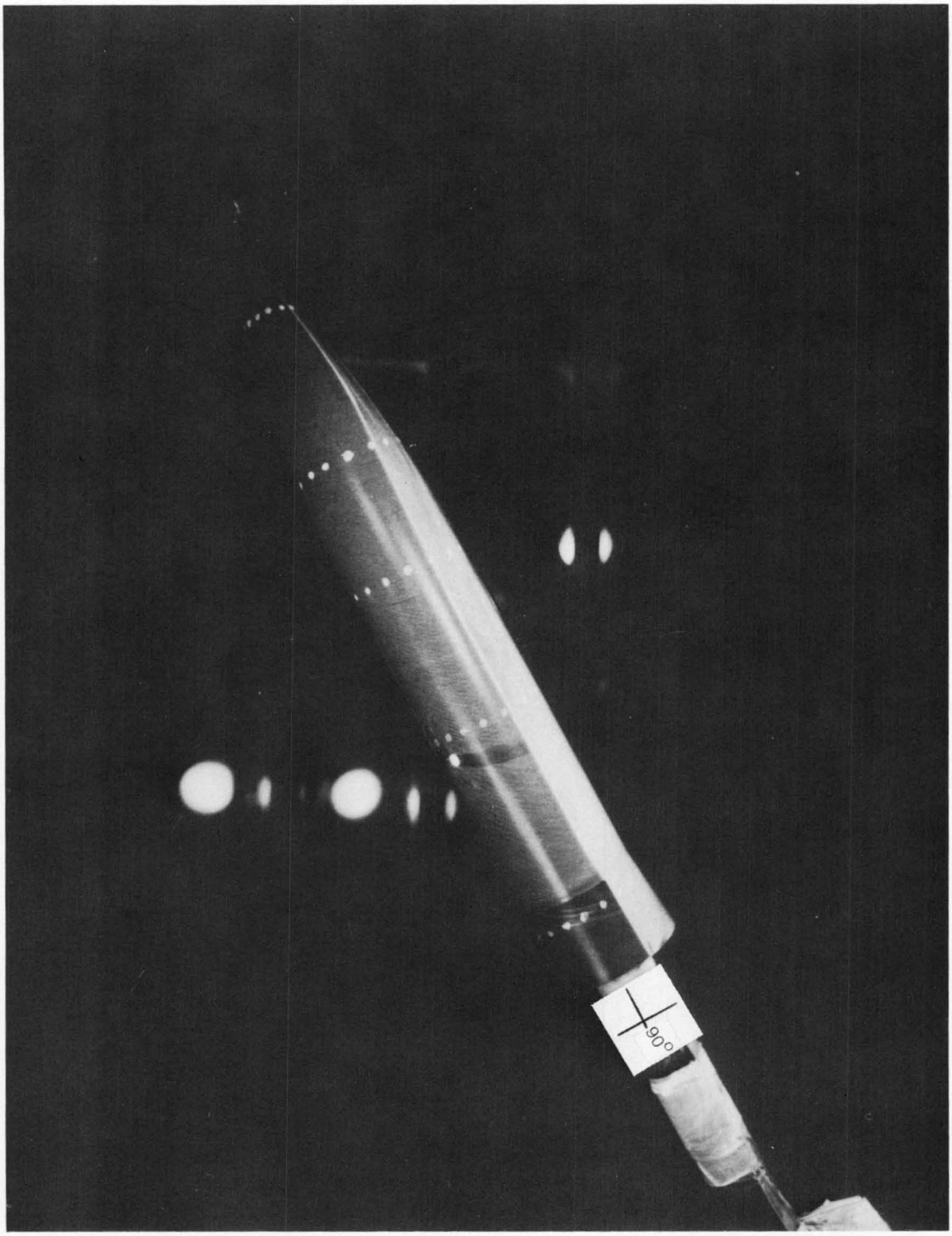
Figure 11.- Continued.



$\alpha = 52^{\circ}$

(c) Continued.

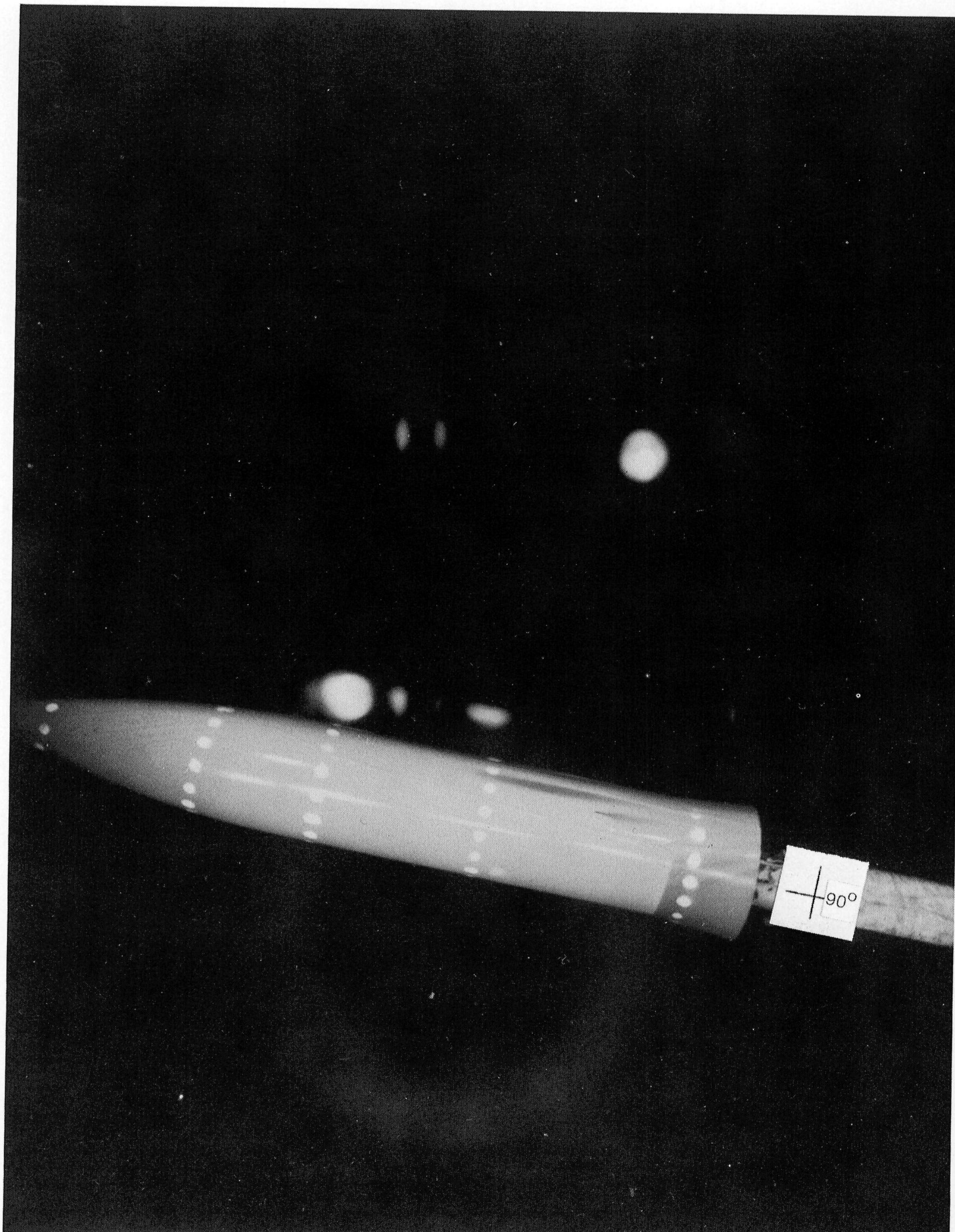
Figure 11.- Continued.



$\alpha = 60^{\circ}$

(c) Concluded.

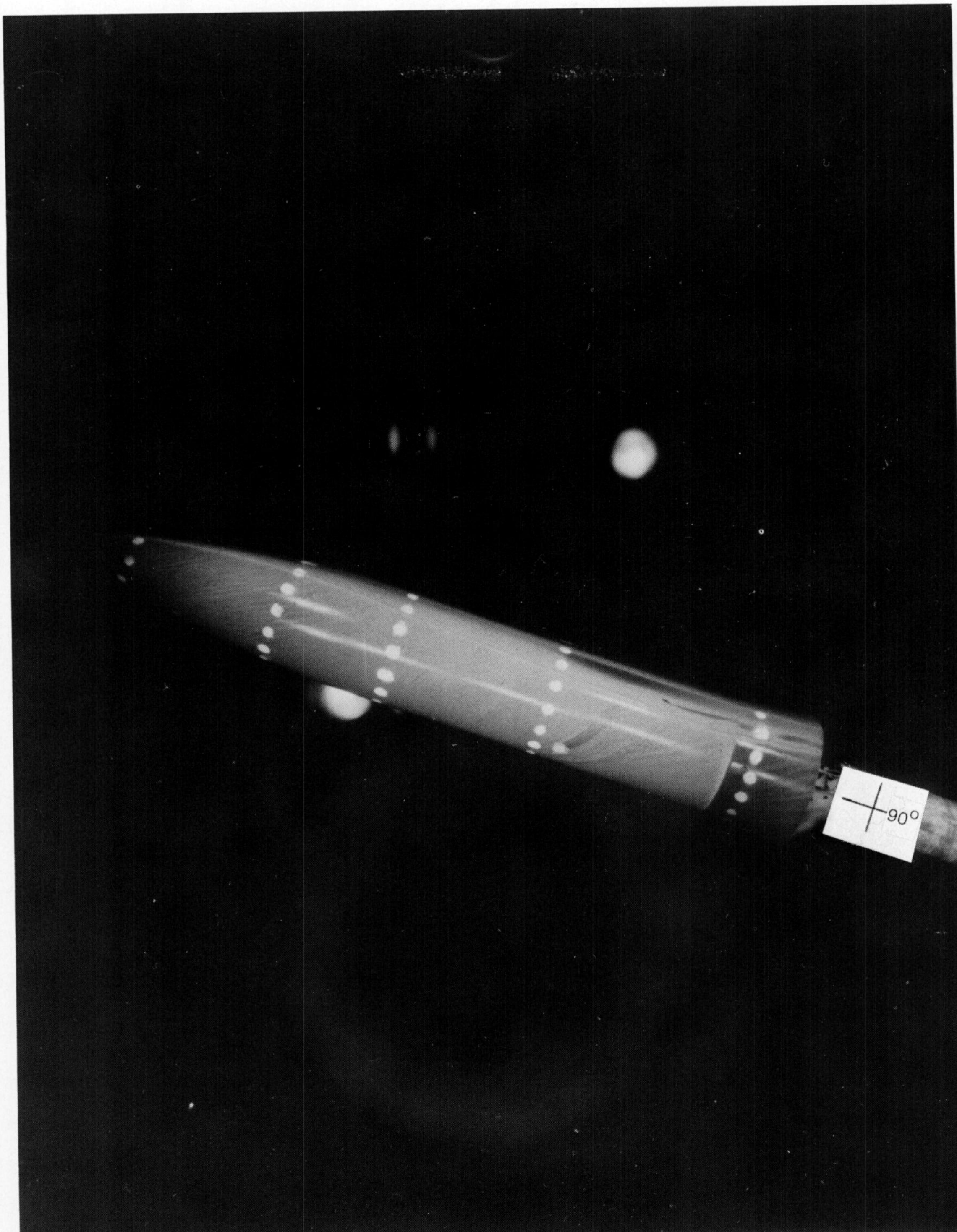
Figure 11.- Continued.



$\alpha = 12^{\circ}$

(d) $M_{\infty} = 4.63$.

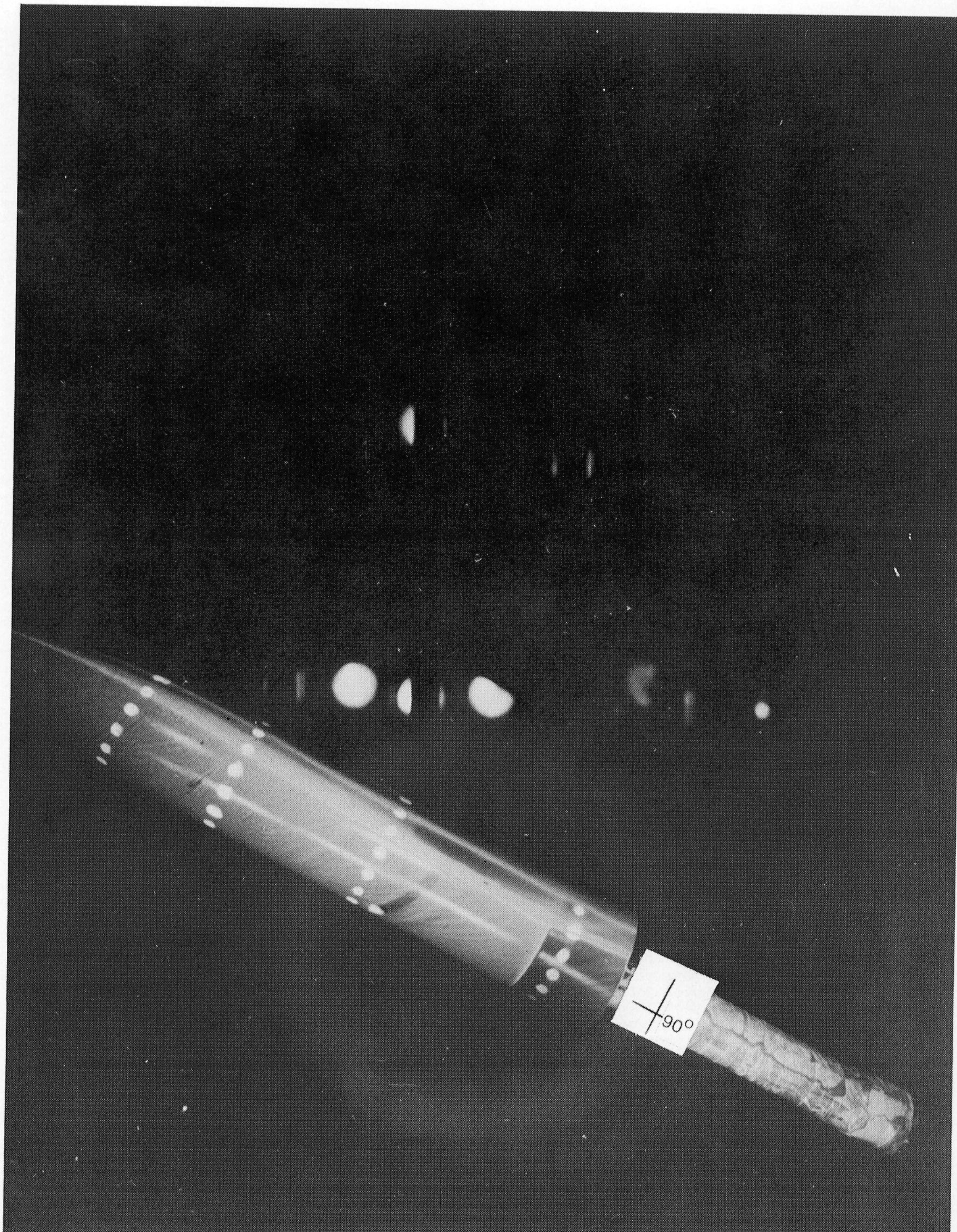
Figure 11.- Continued.



$\alpha = 20^{\circ}$

(d) Continued.

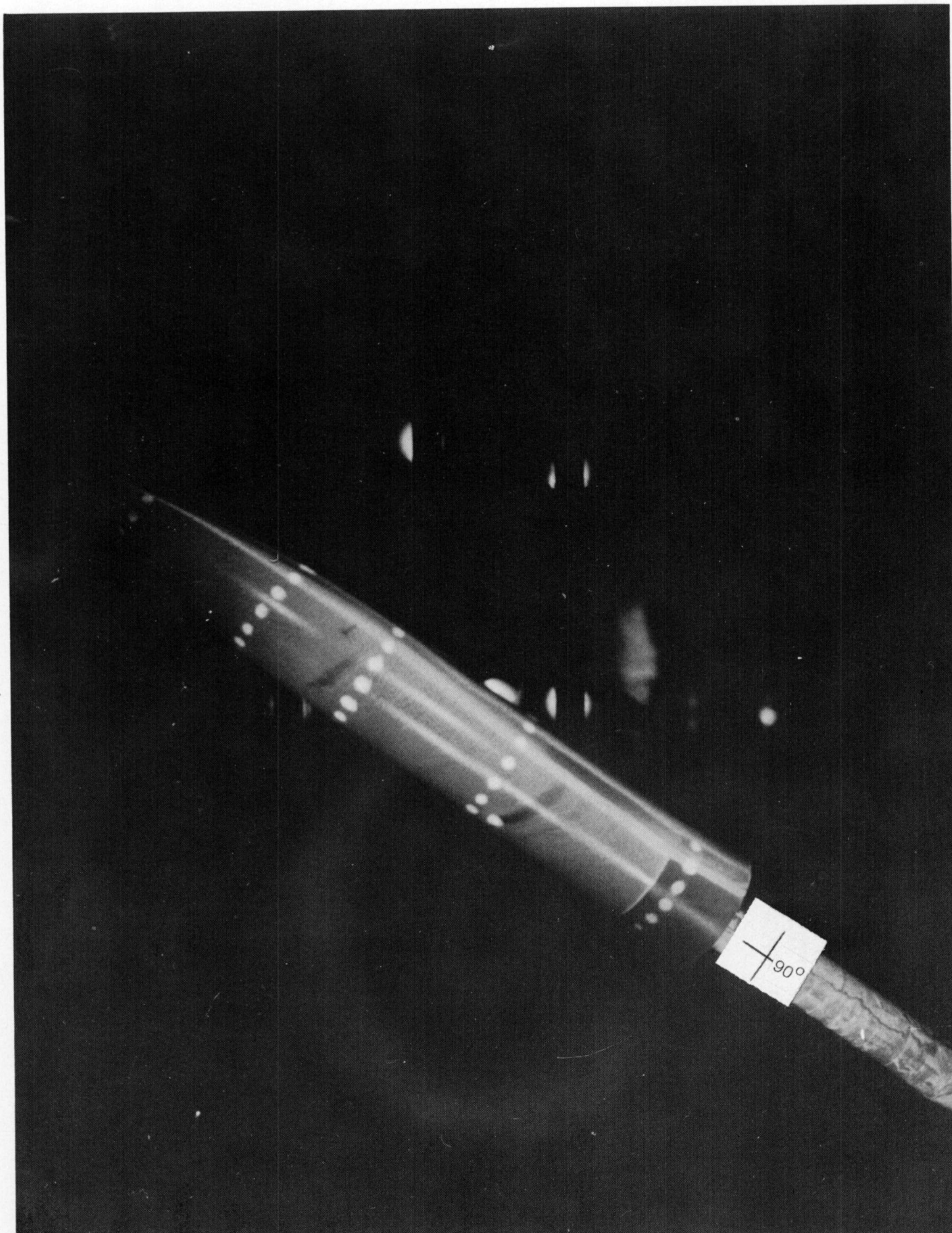
Figure 11.- Continued.



$\alpha = 28^{\circ}$

(d) Continued.

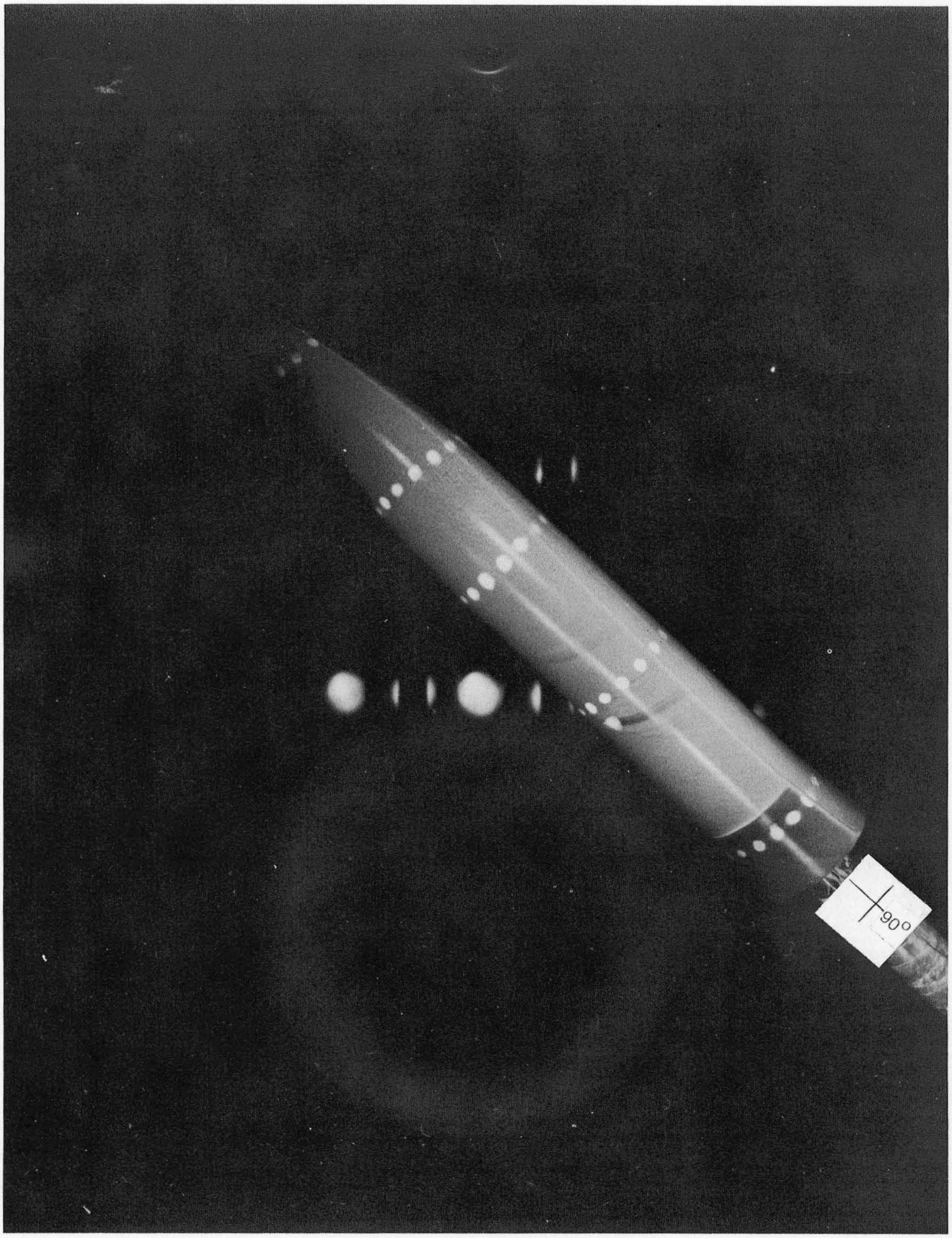
Figure 11.- Continued.



$\alpha = 36^{\circ}$

(d) Continued.

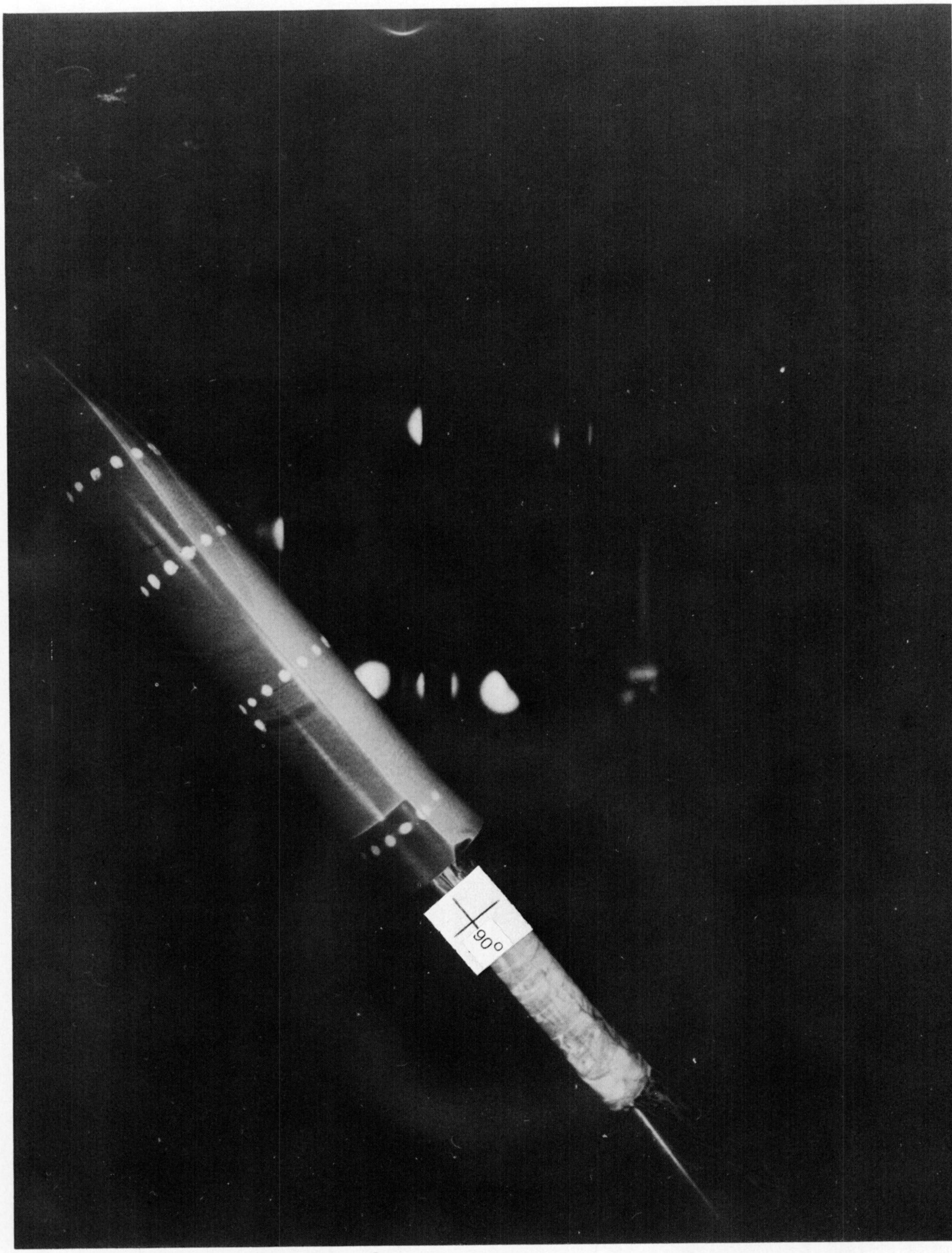
Figure 11.- Continued.



$\alpha = 44^{\circ}$

(d) Continued.

Figure 11.- Continued.



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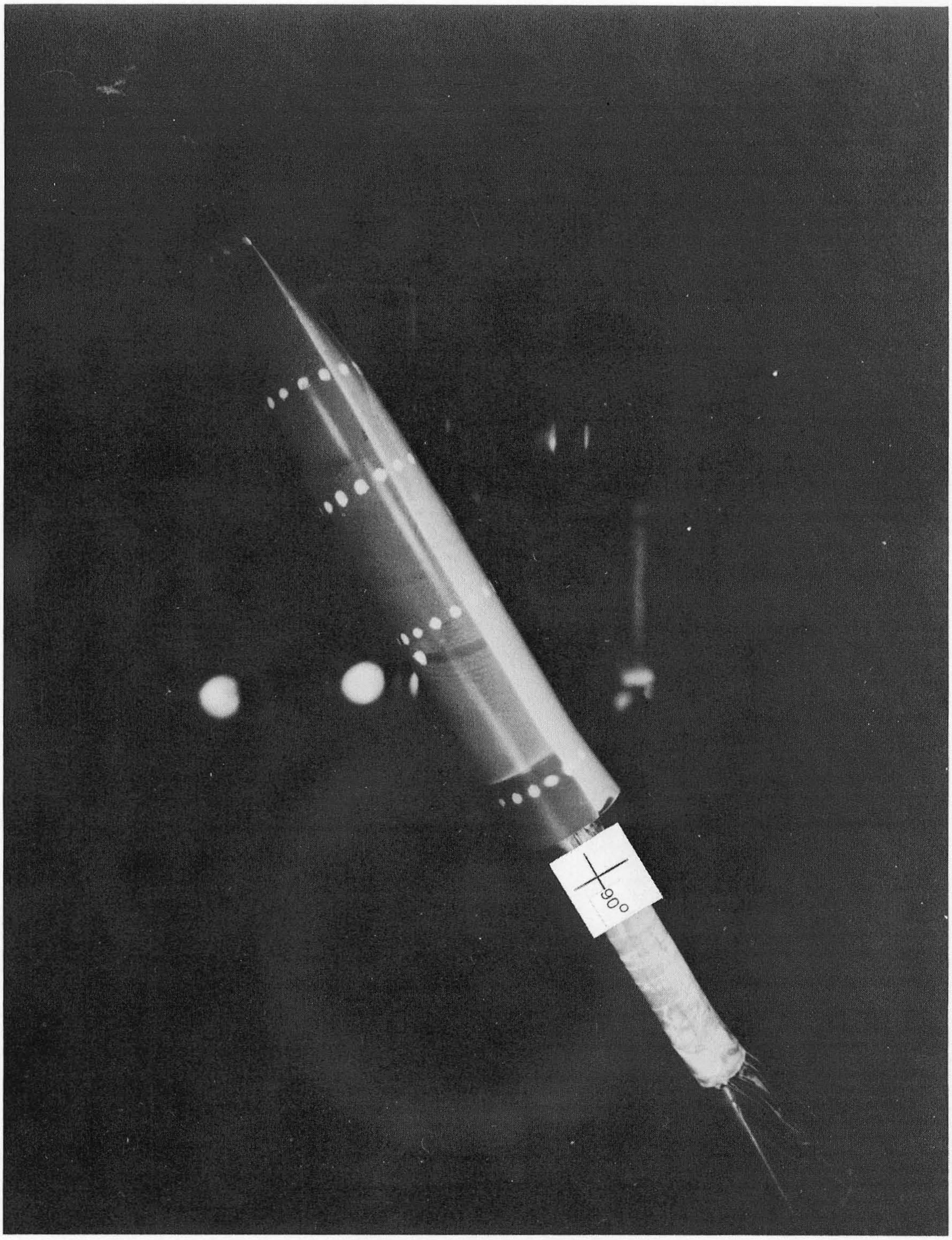
(d) Continued.

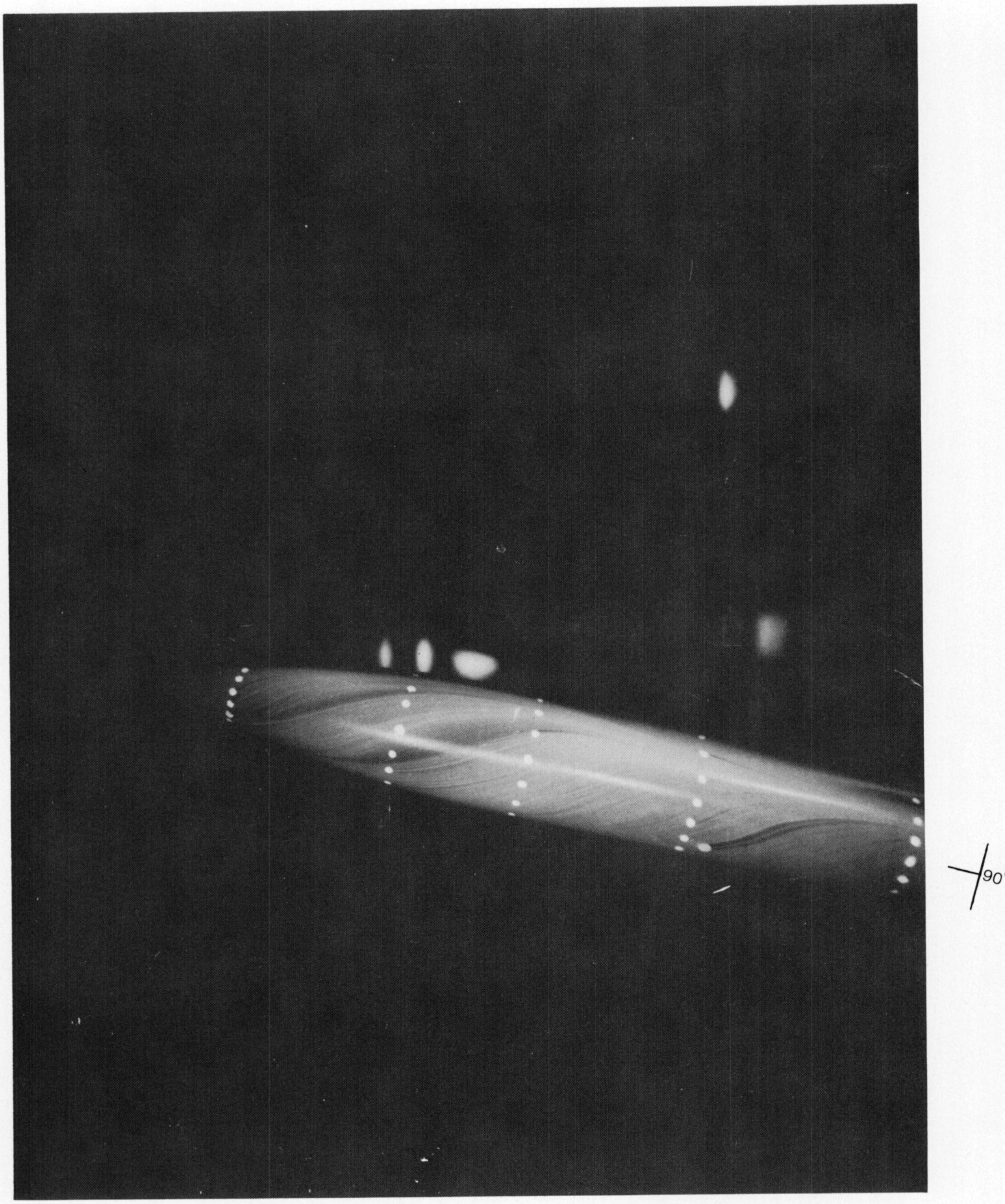
Figure 11.- Continued.



$\alpha = 60^{\circ}$

(d) Concluded.

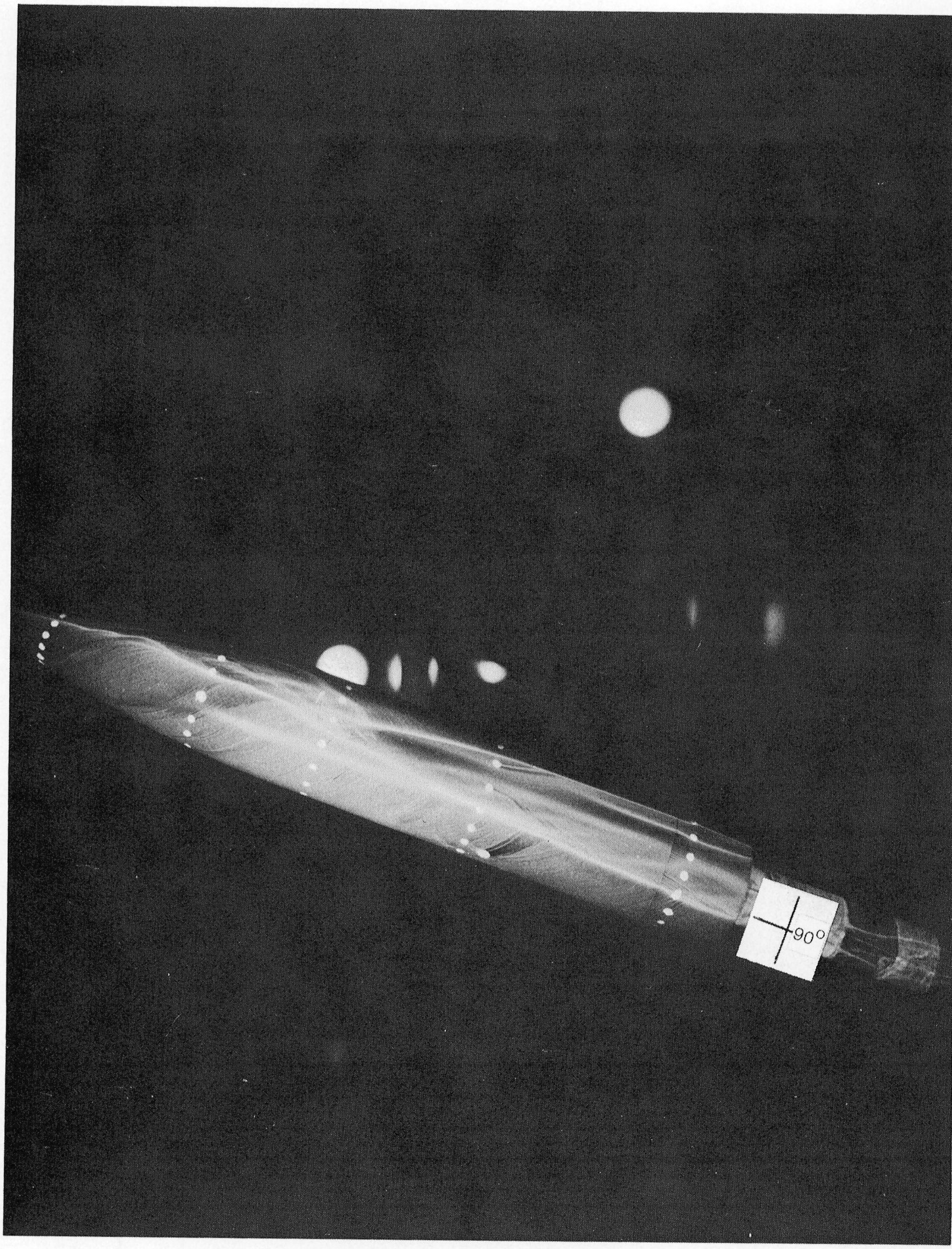
Figure 11.- Concluded.



$\alpha = 12^{\circ}$

(a) $M_{\infty} = 1.6$.

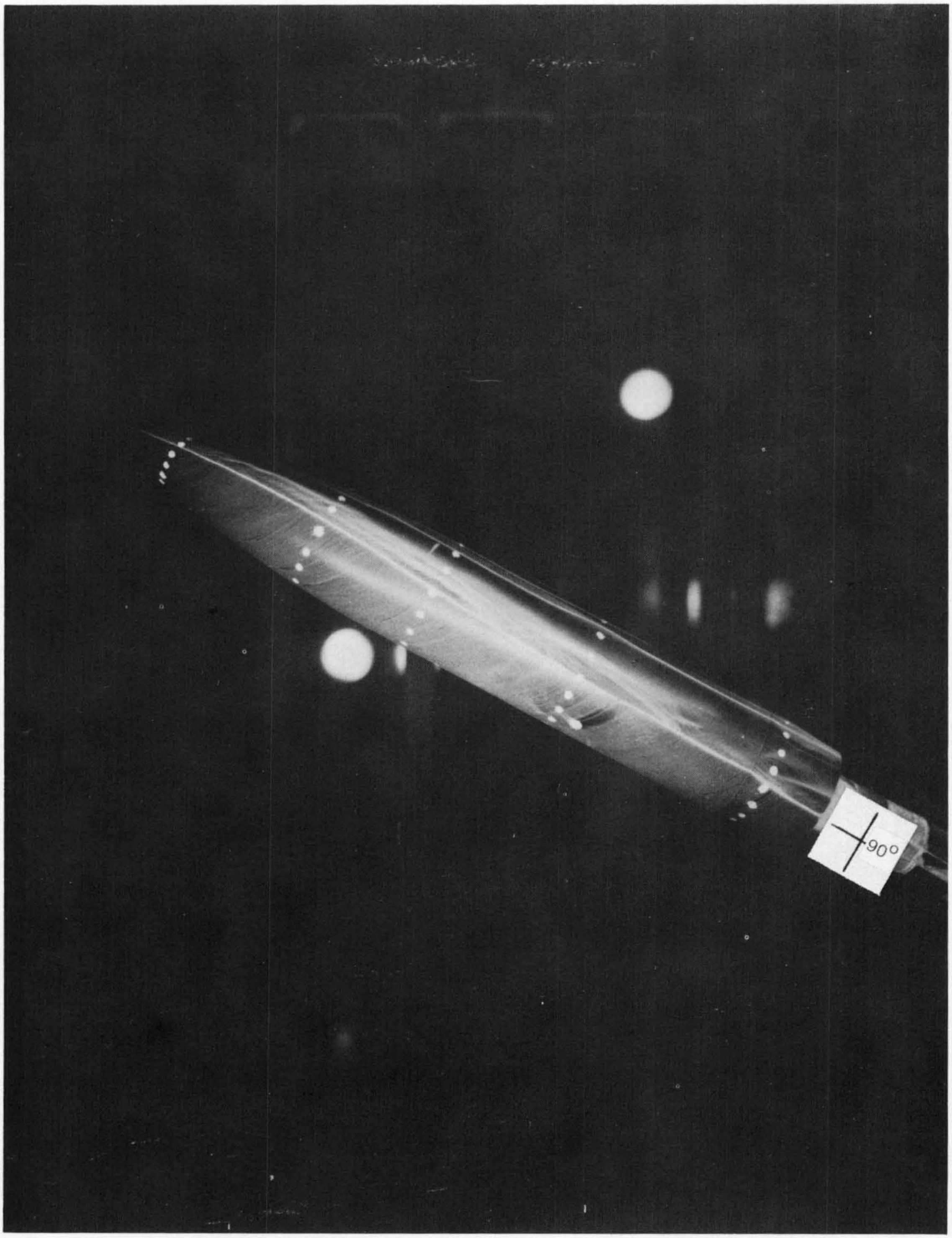
Figure 12.- Oil-flow photographs for circular-arc—cylinder—boattail model.



$\alpha = 20^{\circ}$

(a) Continued.

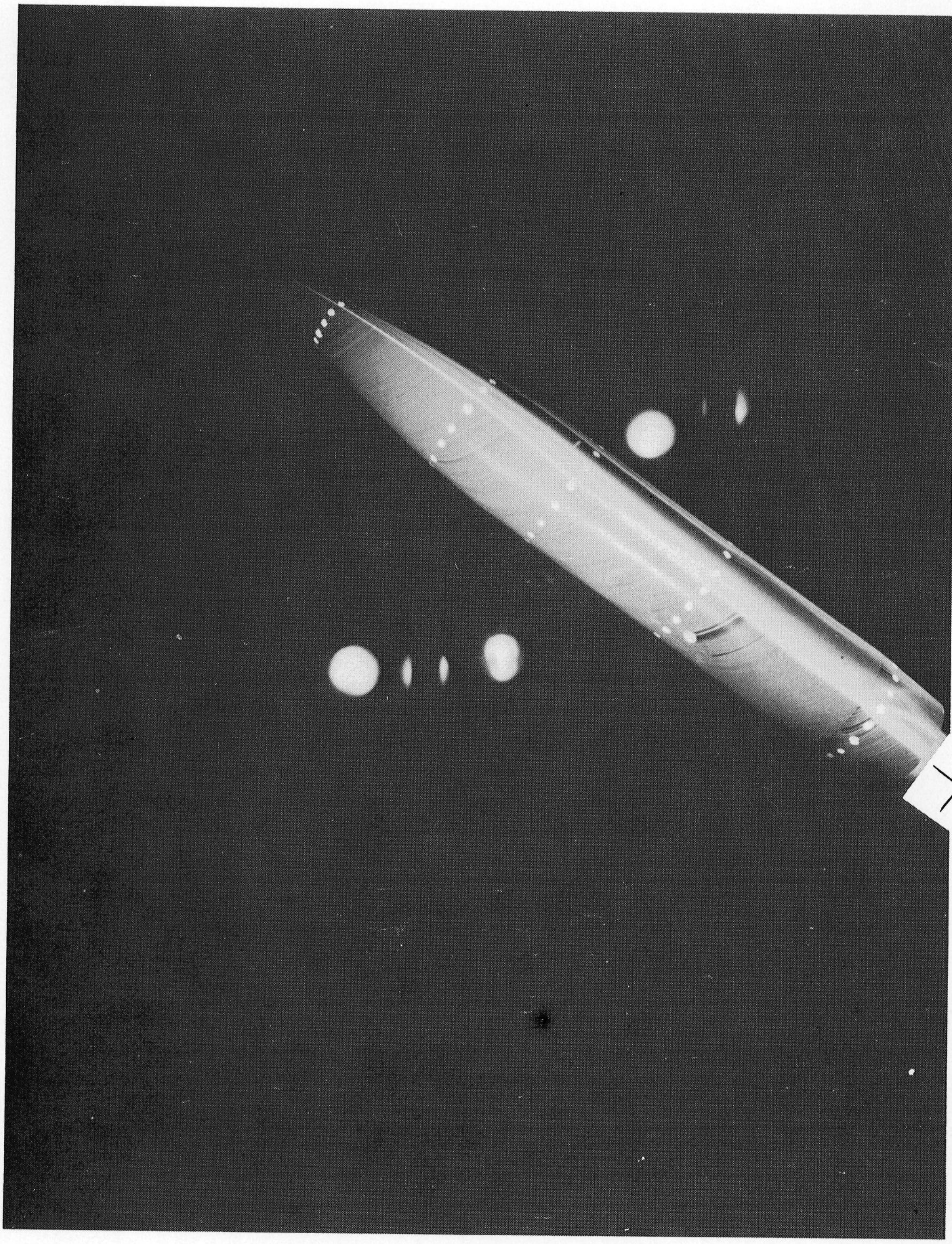
Figure 12.- Continued.



$\alpha = 28^{\circ}$

(a) Continued.

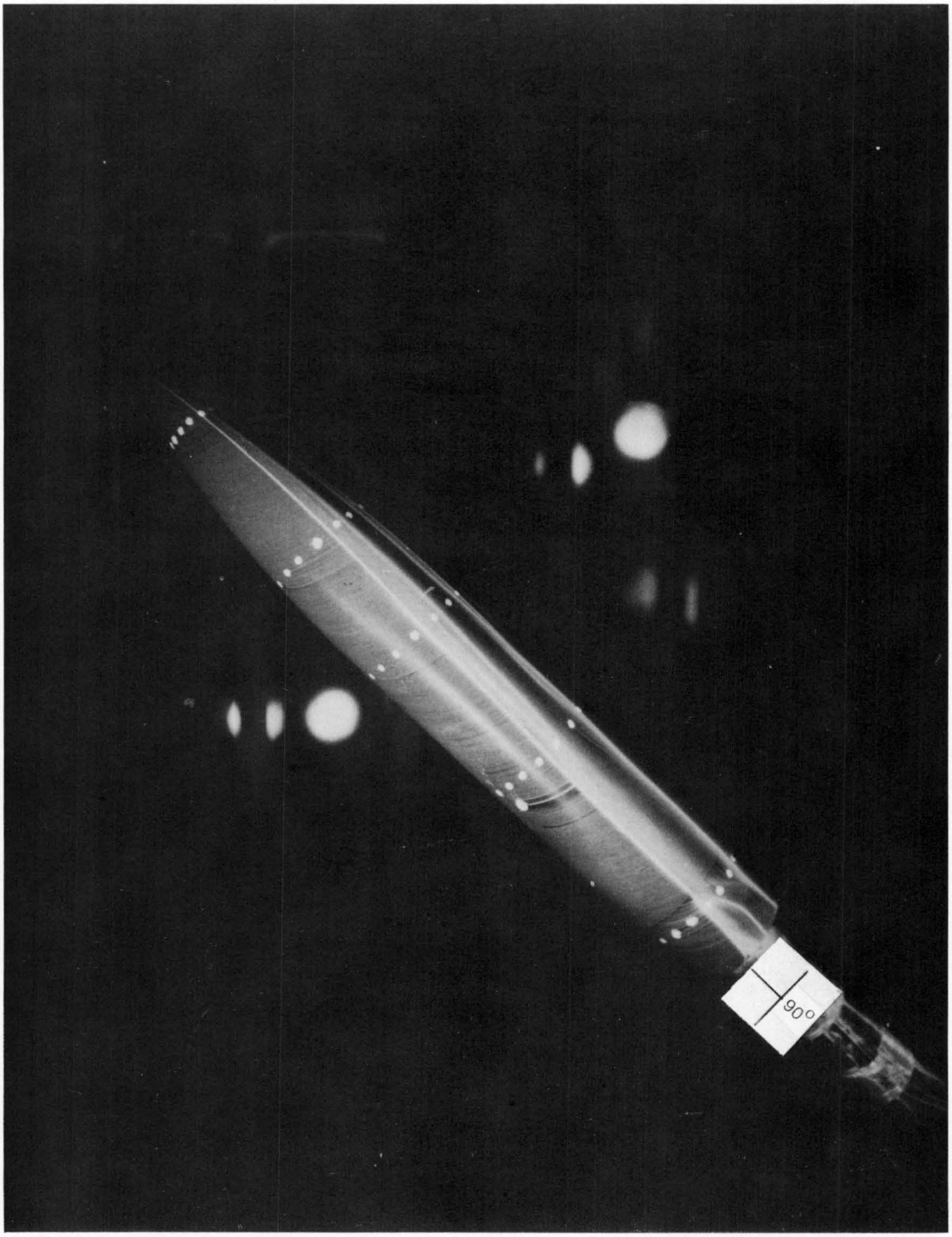
Figure 12.- Continued.



$\alpha = 36^{\circ}$

(a) Continued.

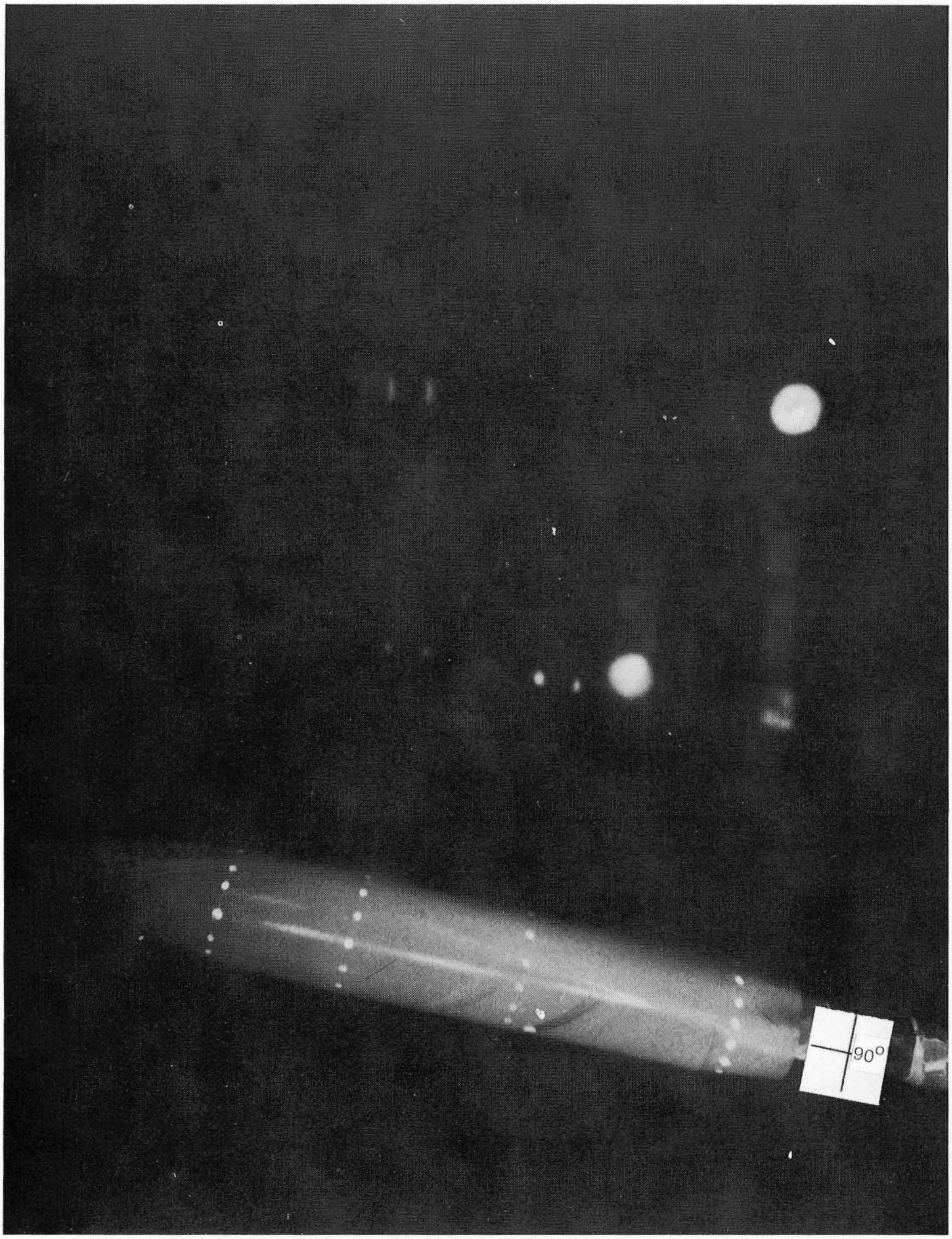
Figure 12.- Continued.



$\alpha = 44^{\circ}$

(a) Concluded.

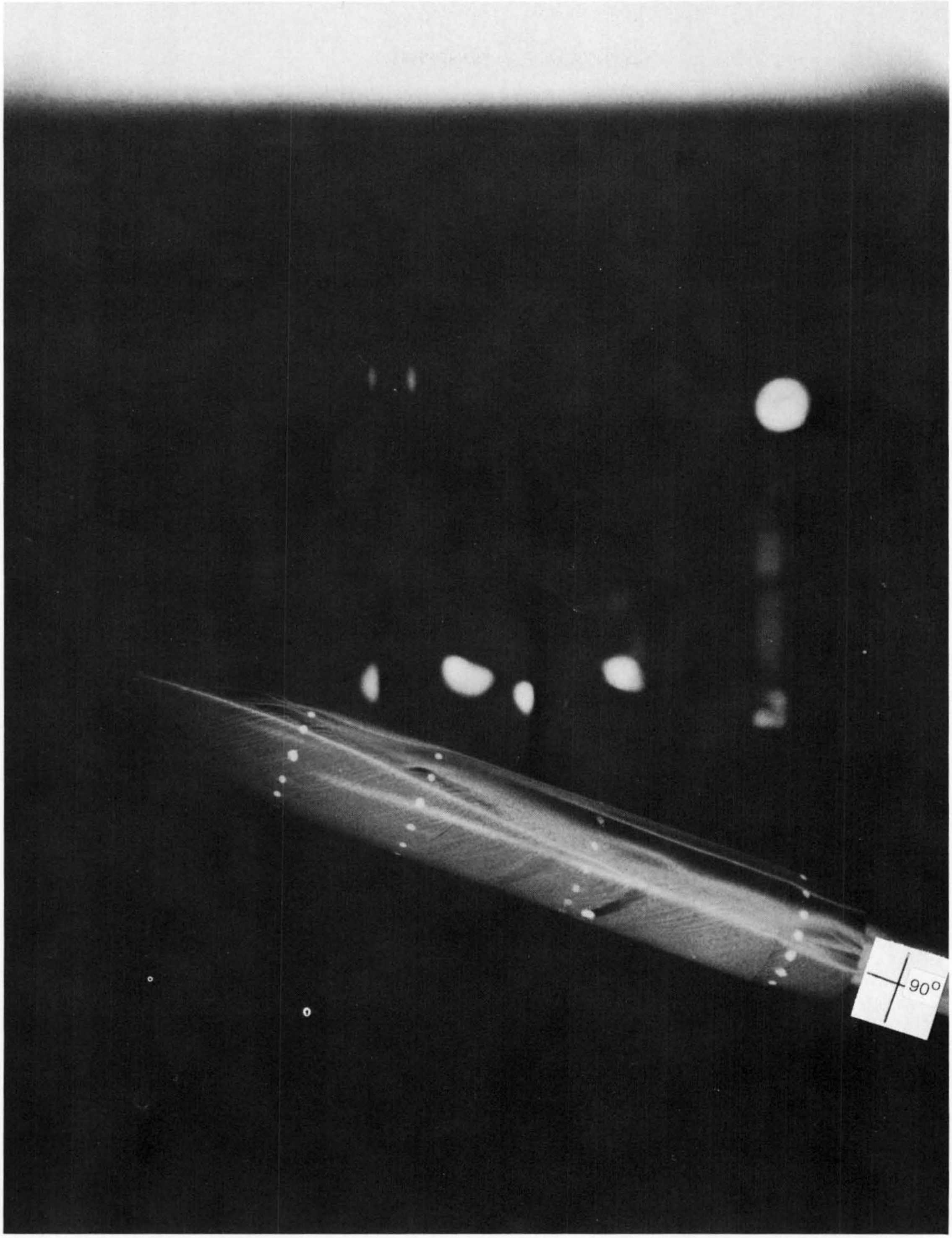
Figure 12.- Continued.



$\alpha = 12^{\circ}$

(b) $M_{\infty} = 2.3$.

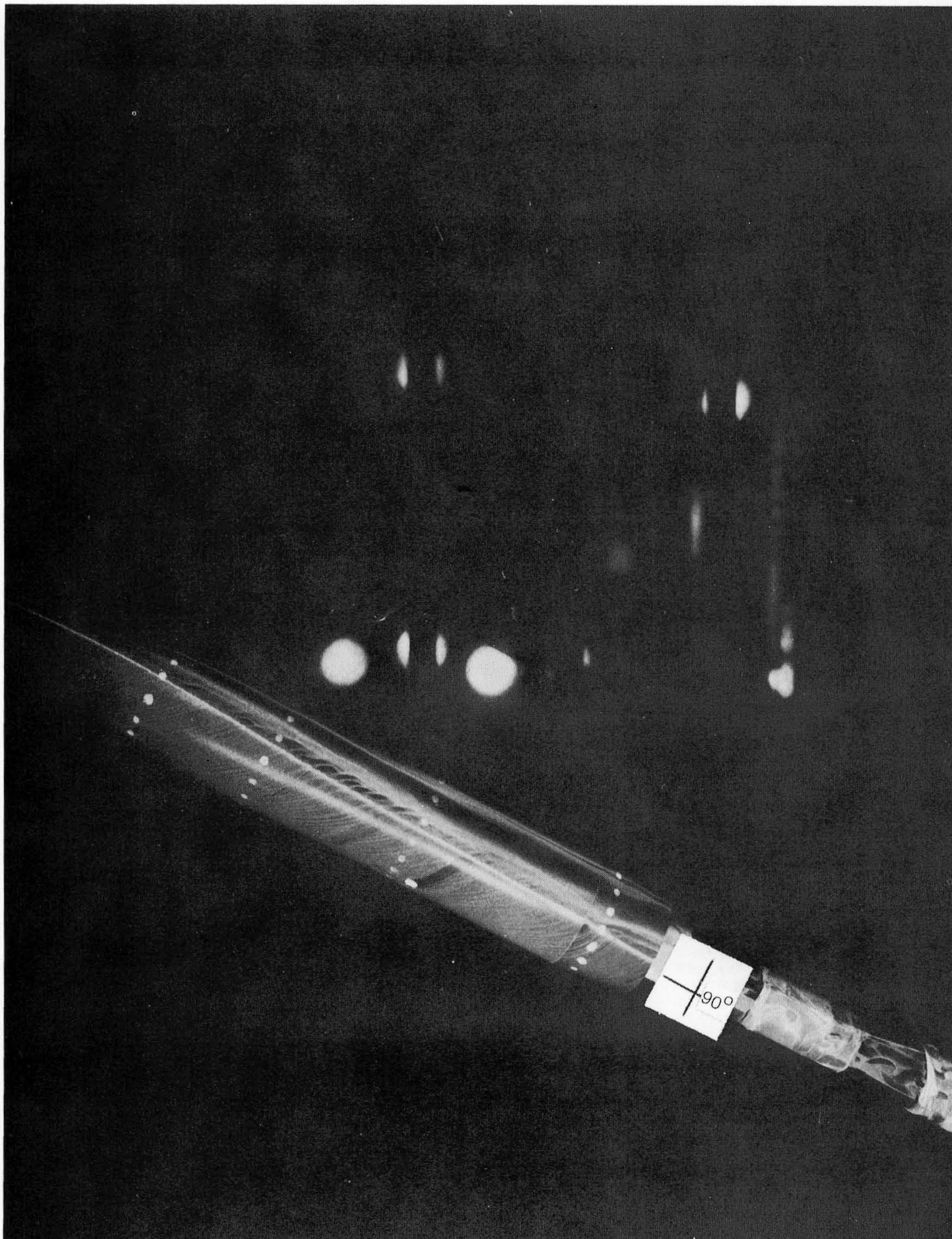
Figure 12.- Continued.



$\alpha = 20^{\circ}$

(b) Continued.

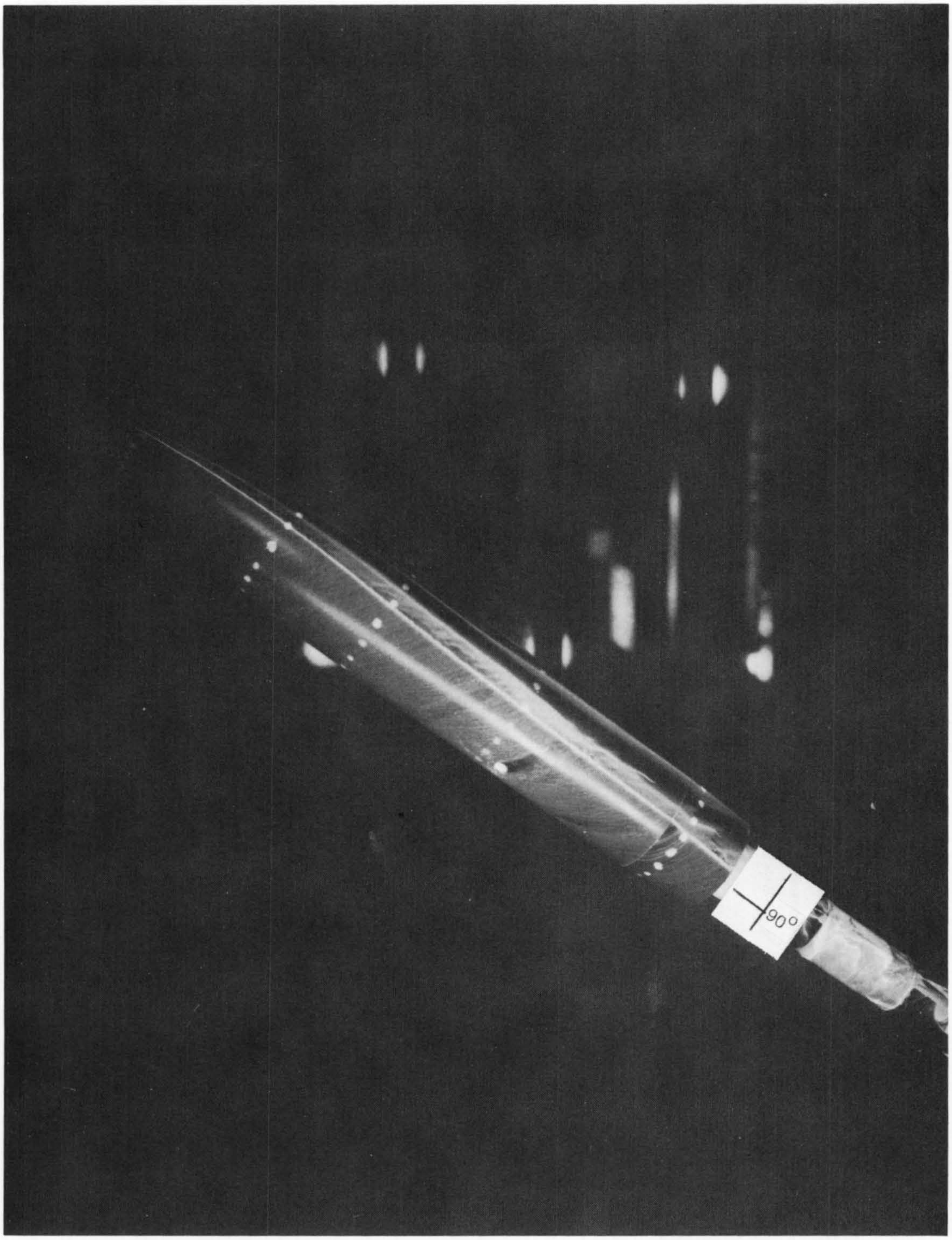
Figure 12.- Continued.



$\alpha = 28^{\circ}$

(b) Continued.

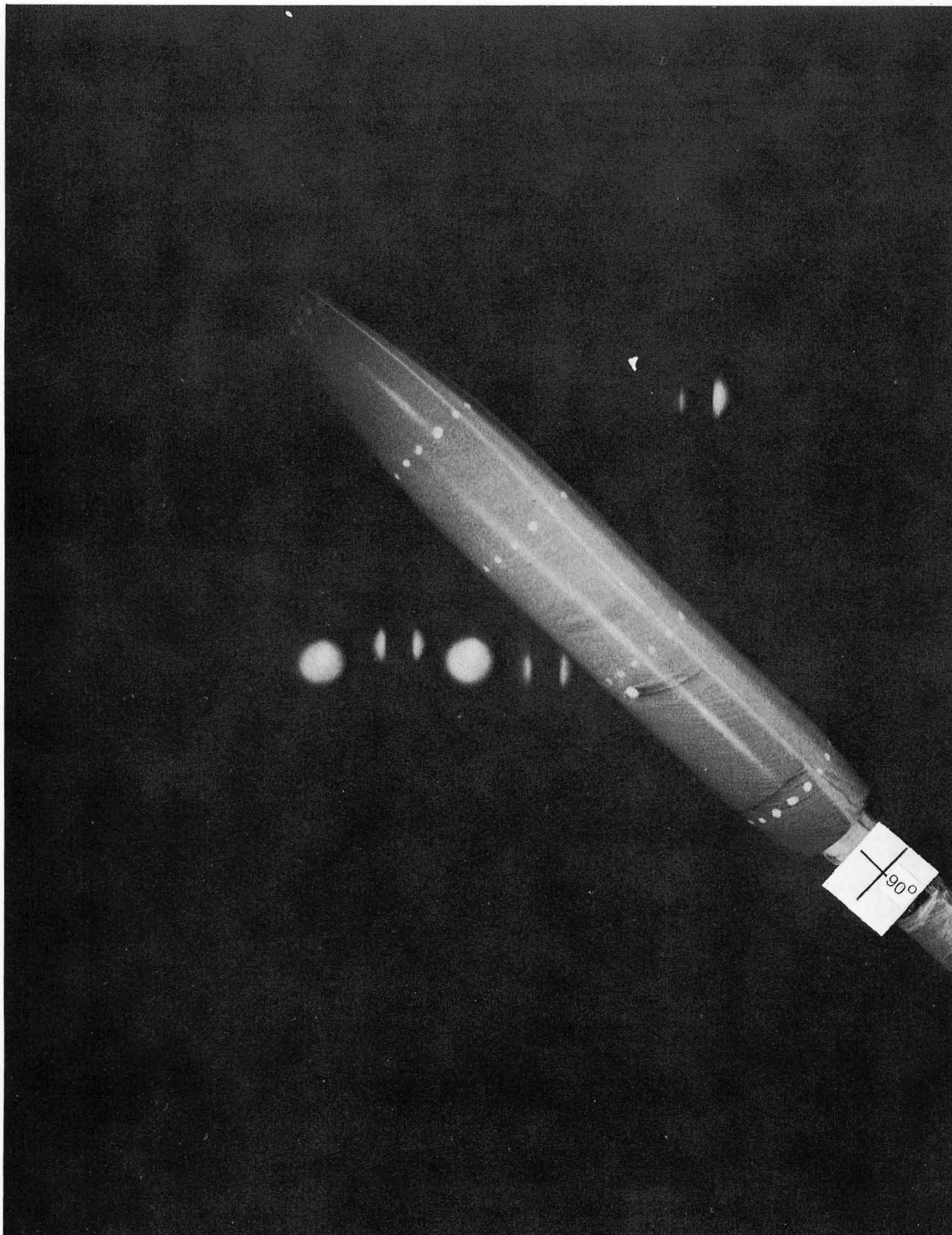
Figure 12.- Continued.



$\alpha = 36^{\circ}$

(b) Continued.

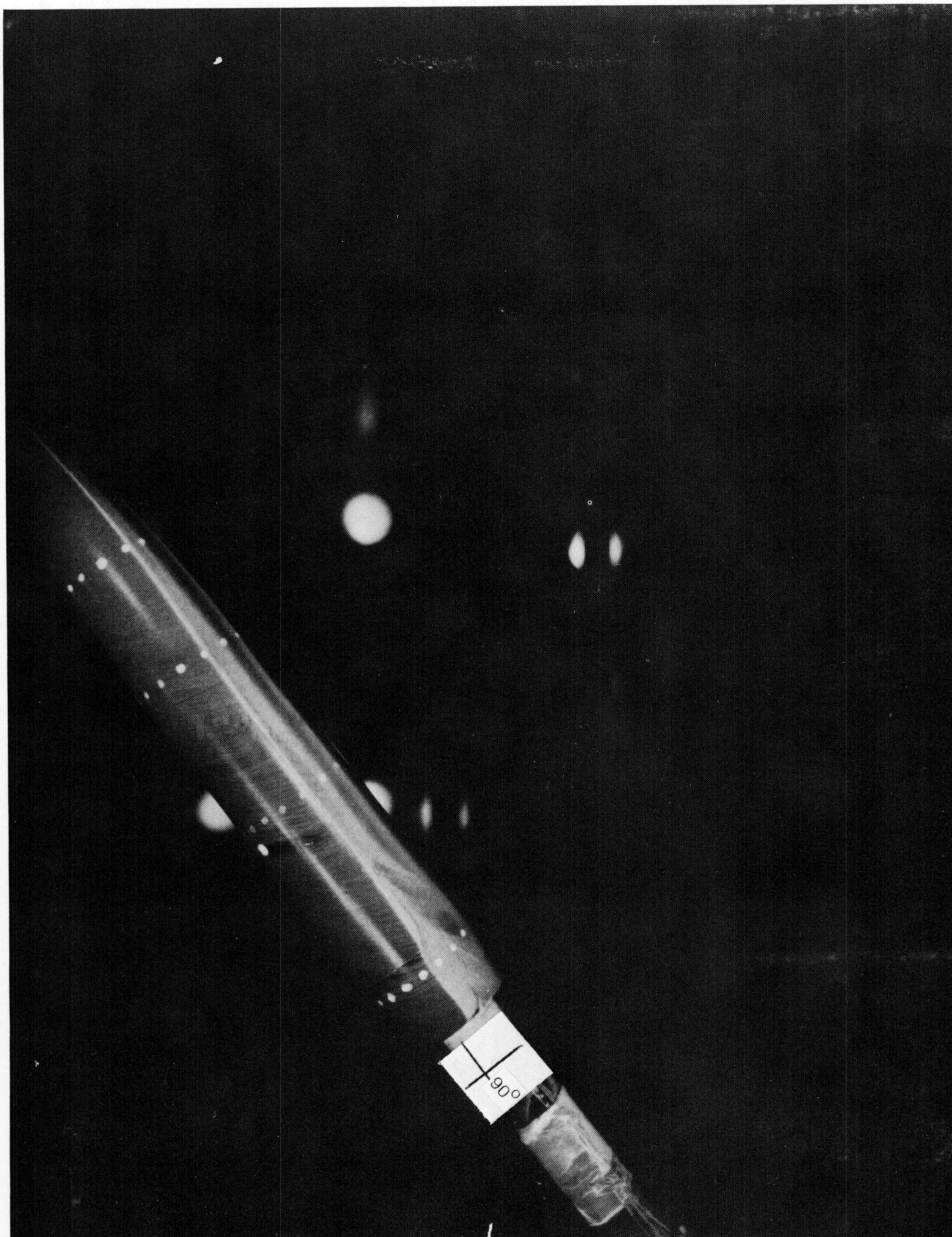
Figure 12.- Continued.



$\alpha = 44^{\circ}$

(b) Continued.

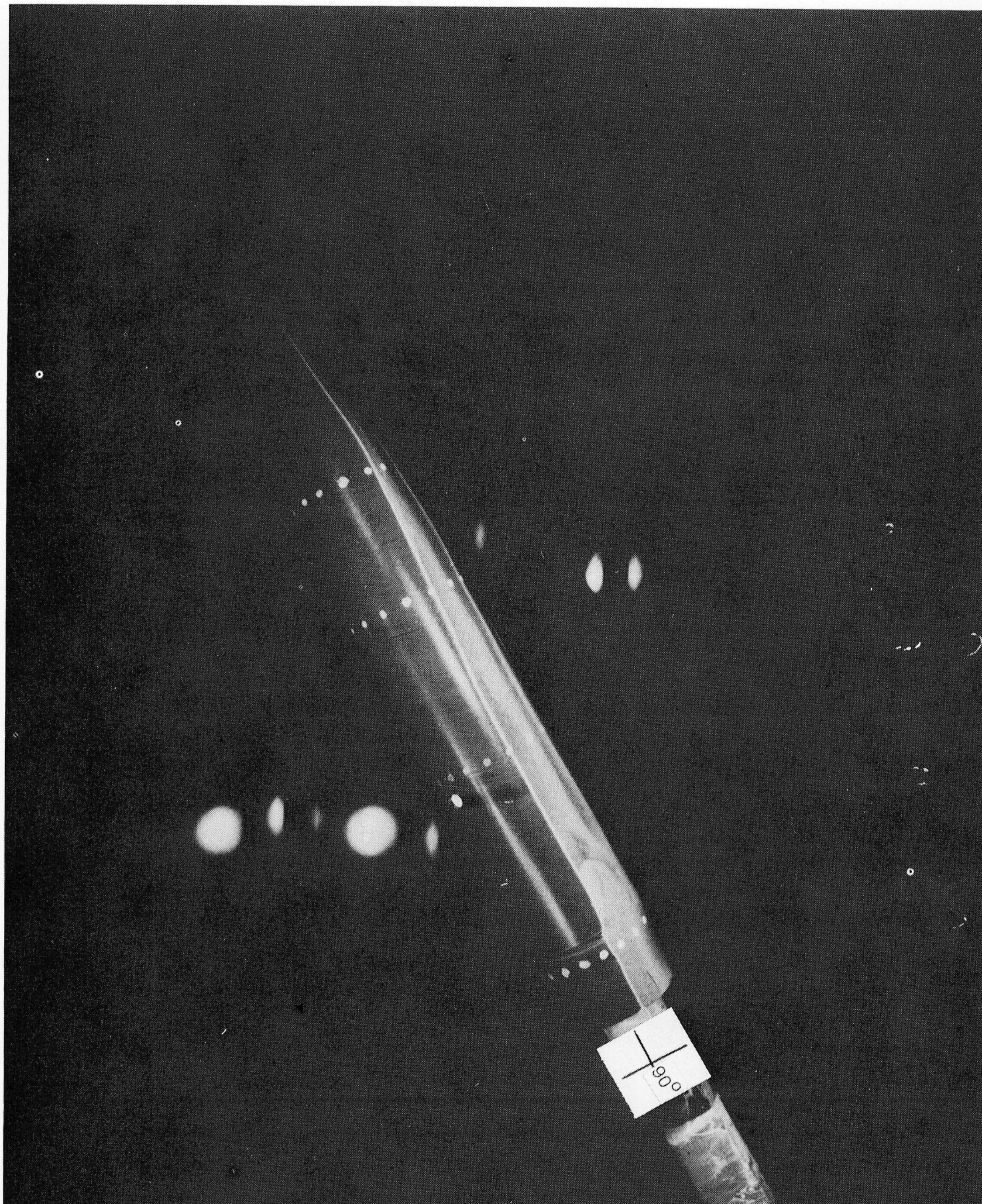
Figure 12.- Continued.



$\alpha = 52^{\circ}$

(b) Continued.

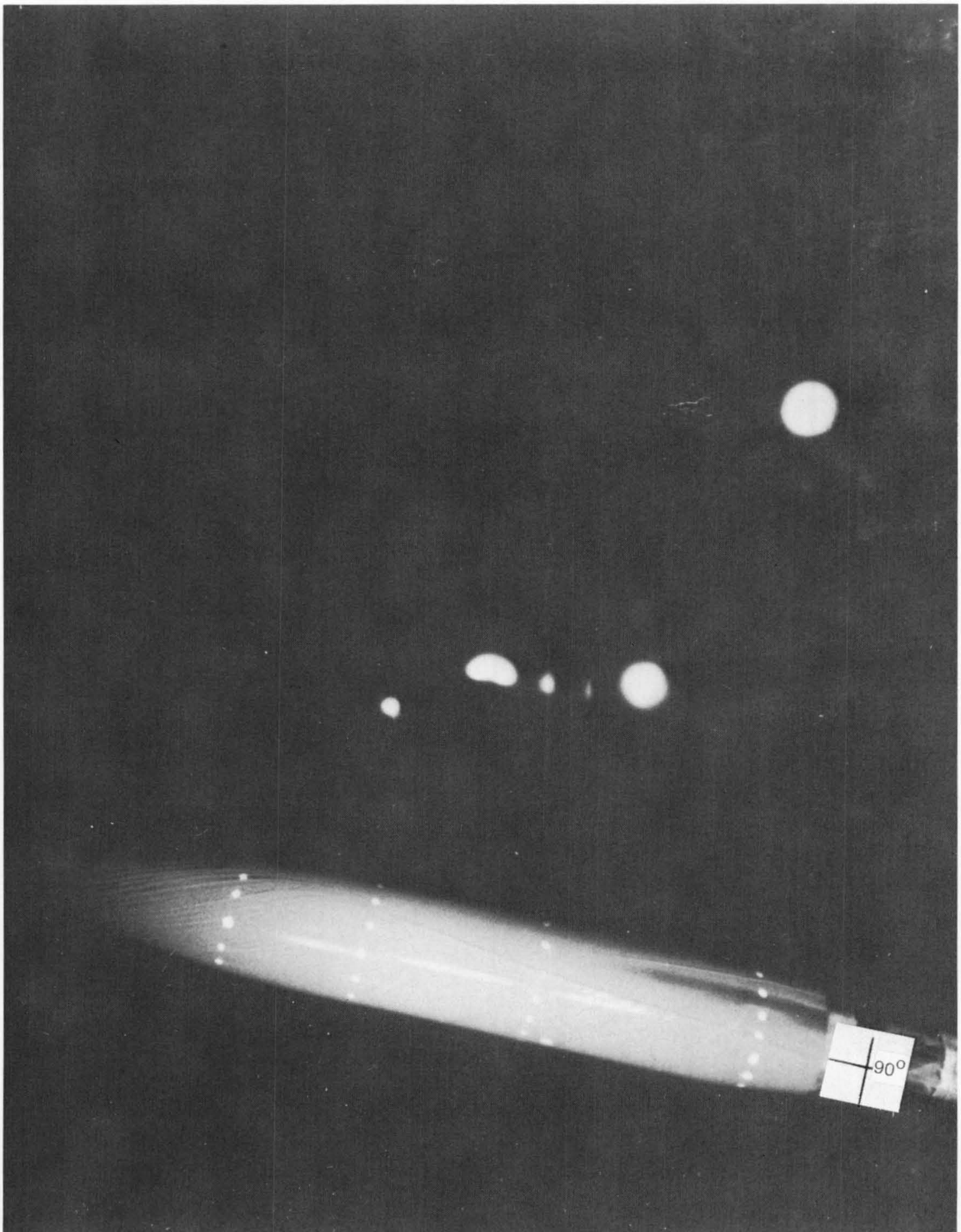
Figure 12.- Continued.



$\alpha = 60^\circ$

(b) Concluded.

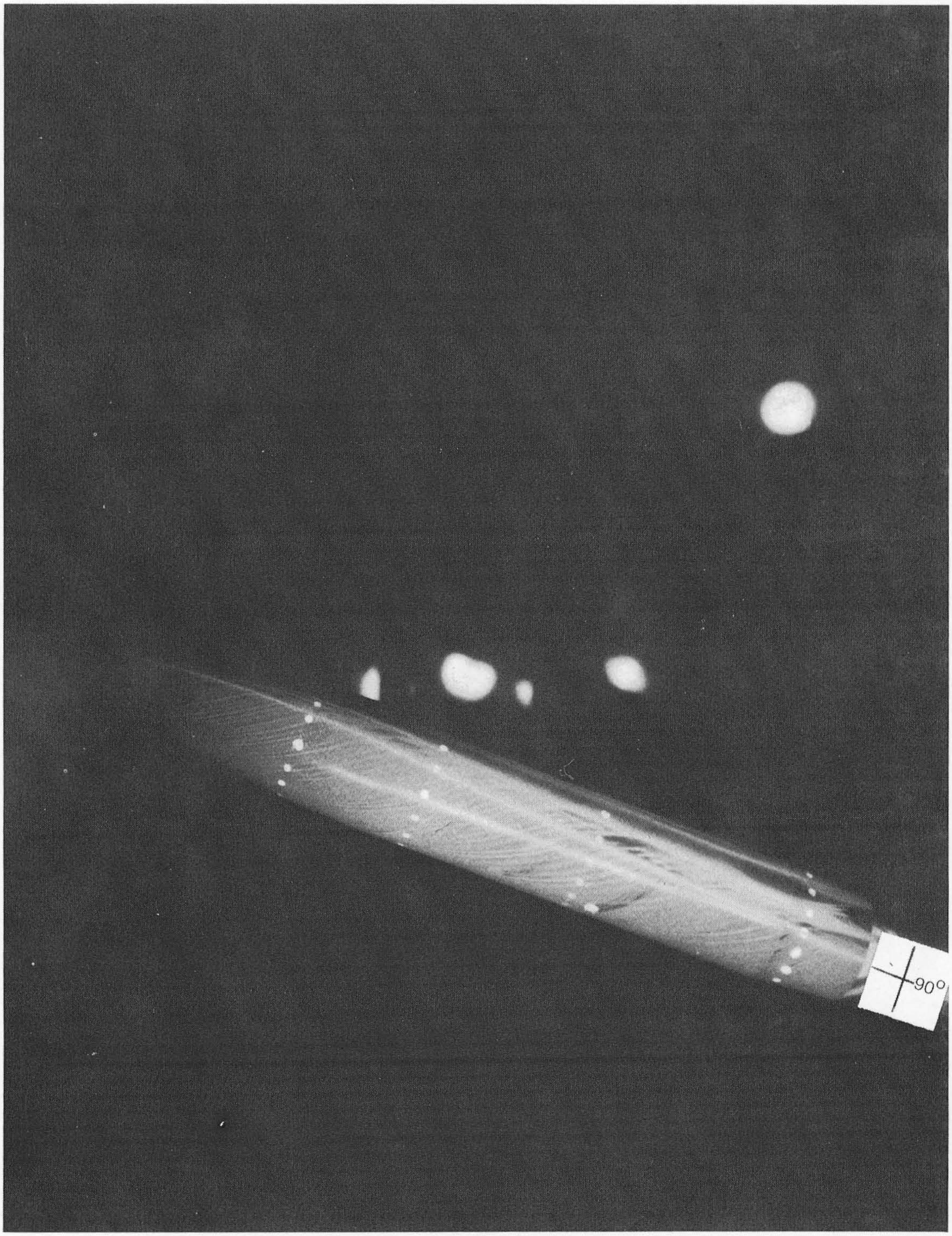
Figure 12.- Continued.



$\alpha = 12^{\circ}$

(c) $M_{\infty} = 2.96$.

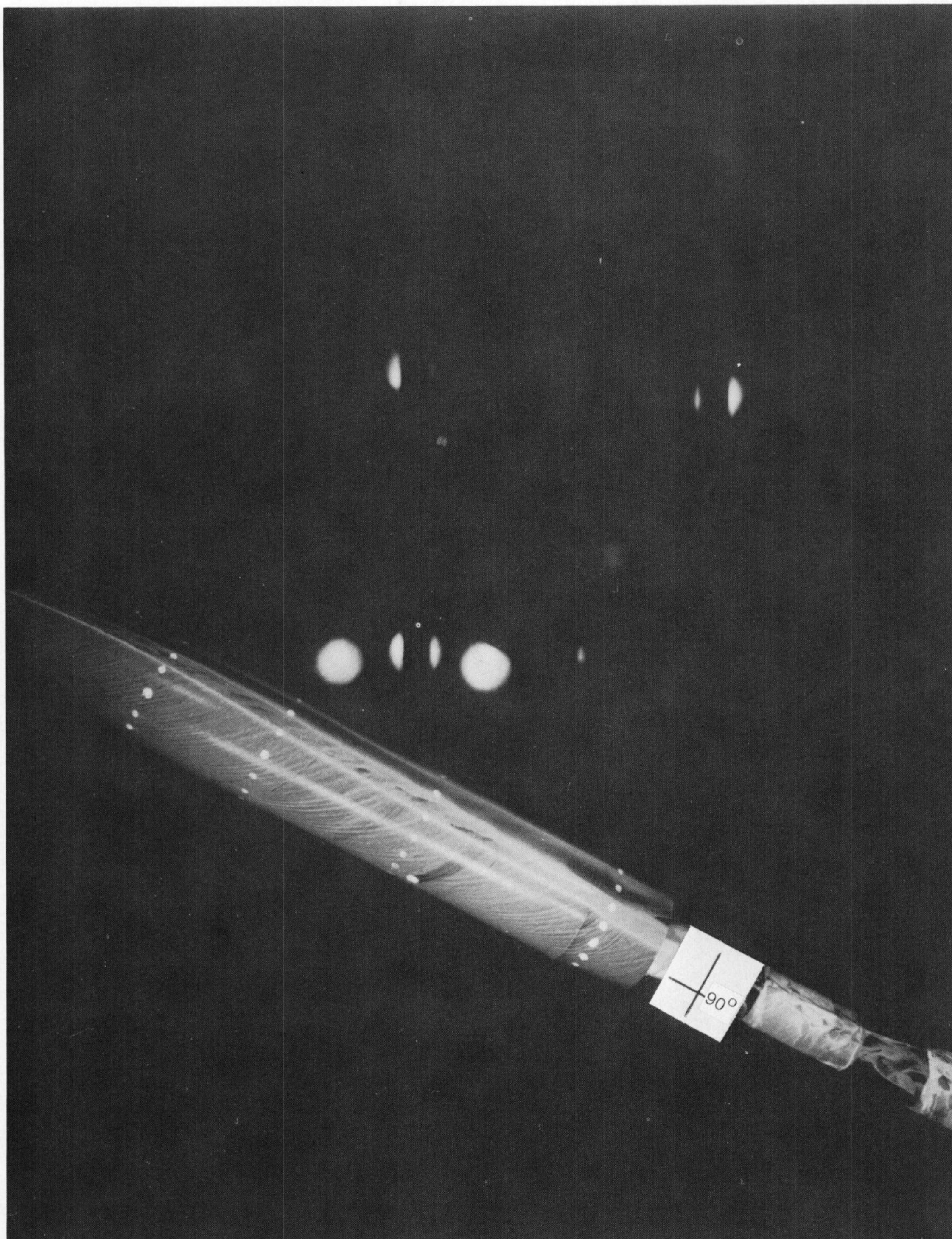
Figure 12.- Continued.



$\alpha = 20^{\circ}$

(c) Continued.

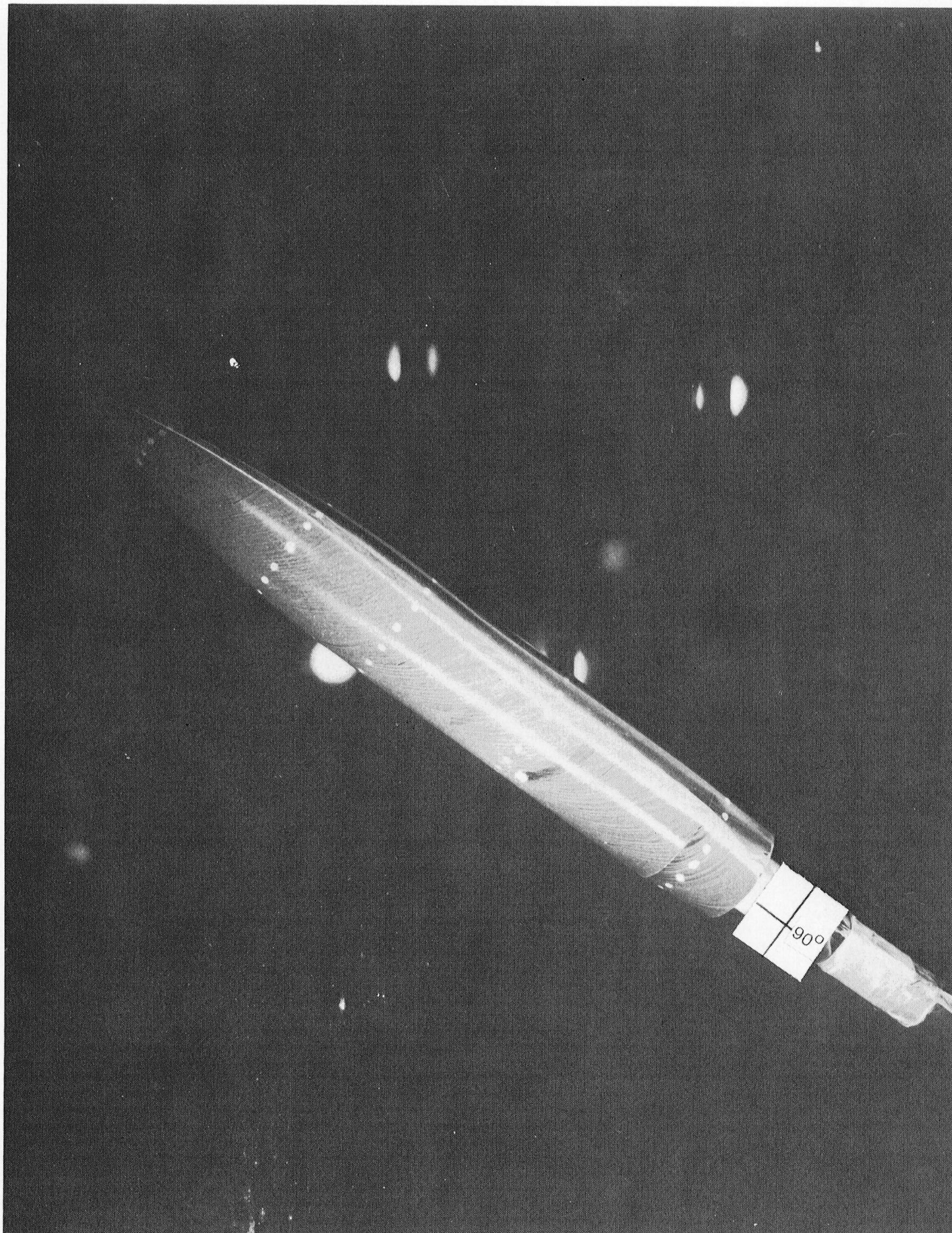
Figure 12.- Continued.



$\alpha = 28^{\circ}$

(c) Continued.

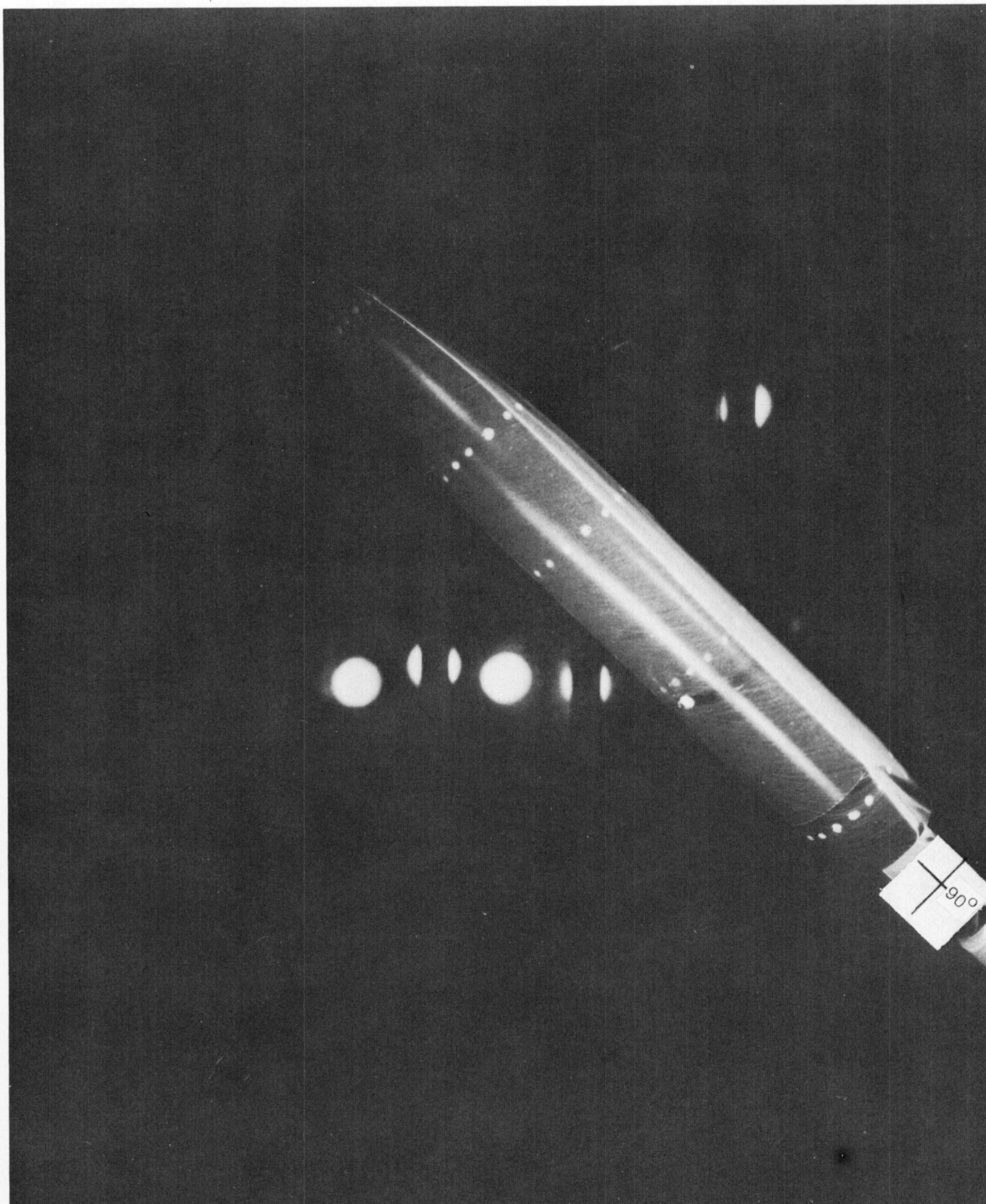
Figure 12.- Continued.



$\alpha = 36^{\circ}$

(c) Continued.

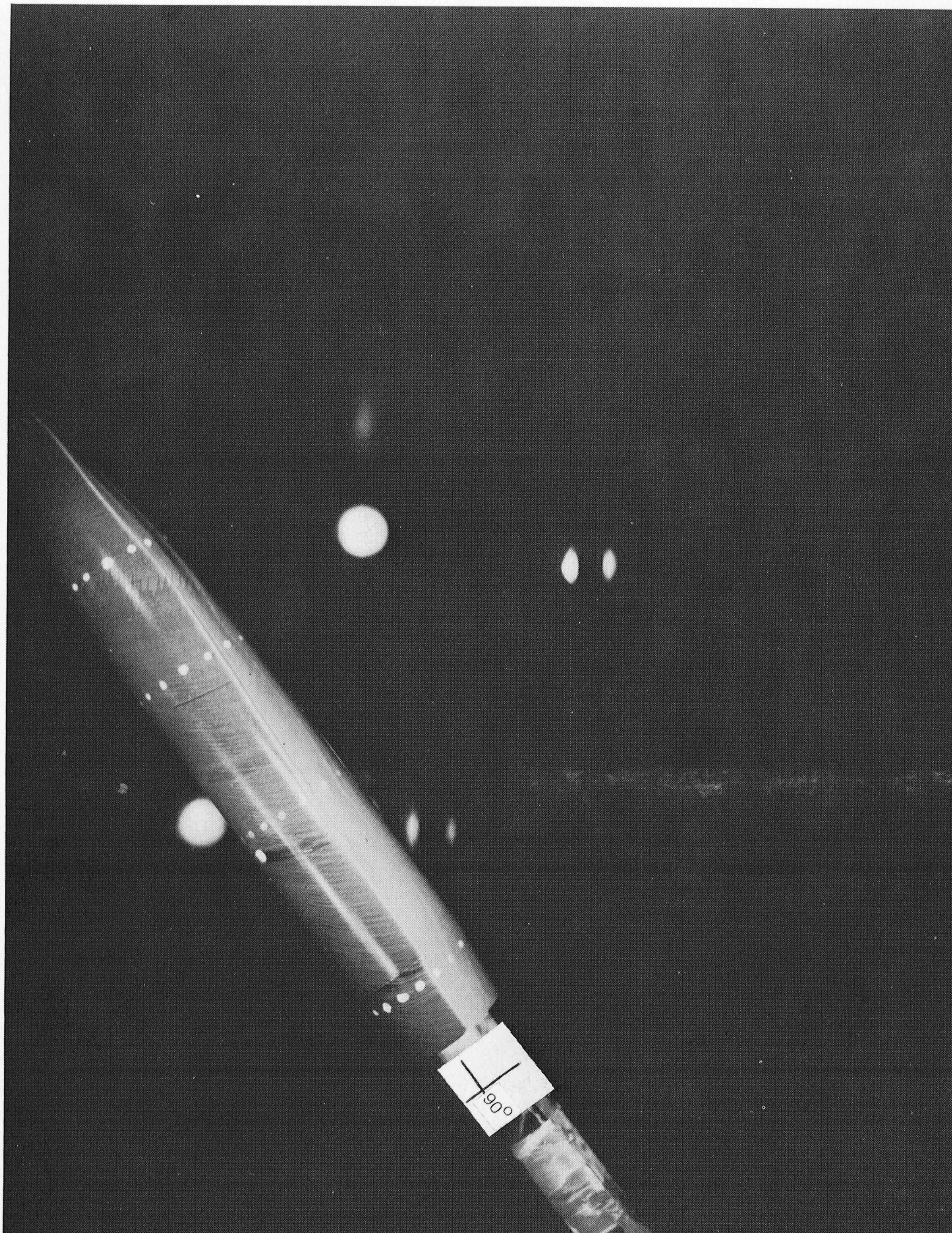
Figure 12.- Continued.



$\alpha = 44^{\circ}$

(c) Continued.

Figure 12.- Continued.



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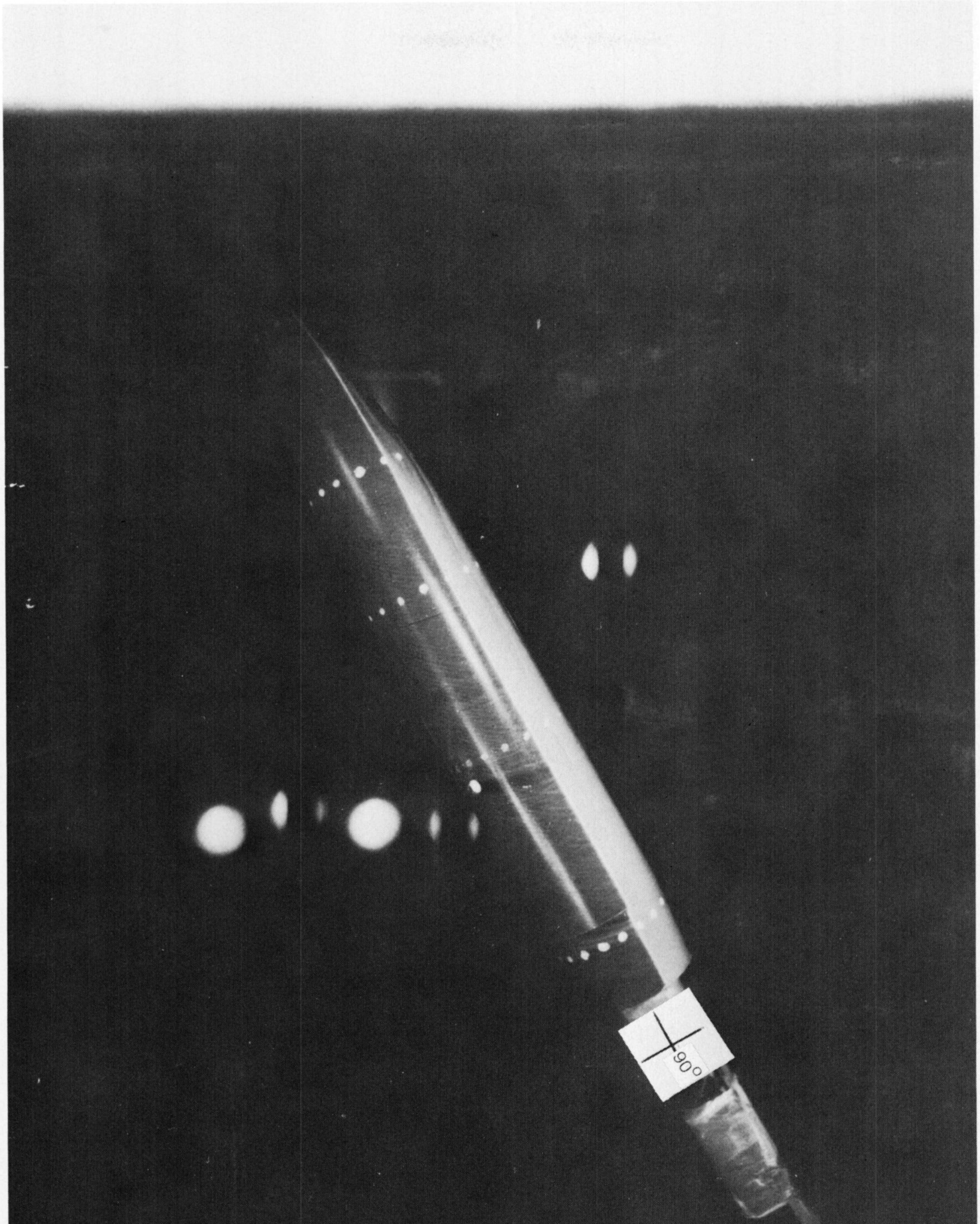
(c) Continued.

Figure 12.- Continued.



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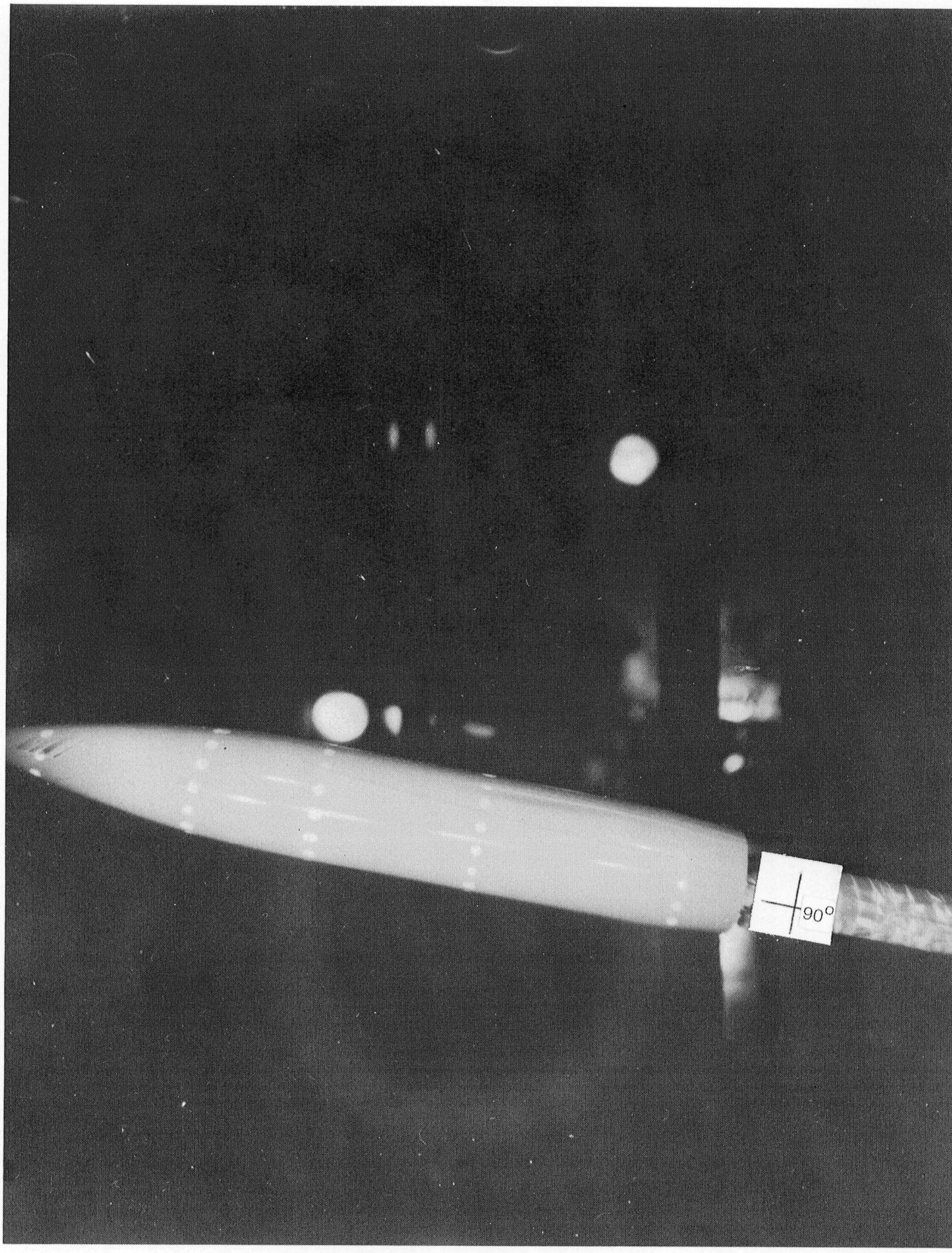
(c) Concluded.

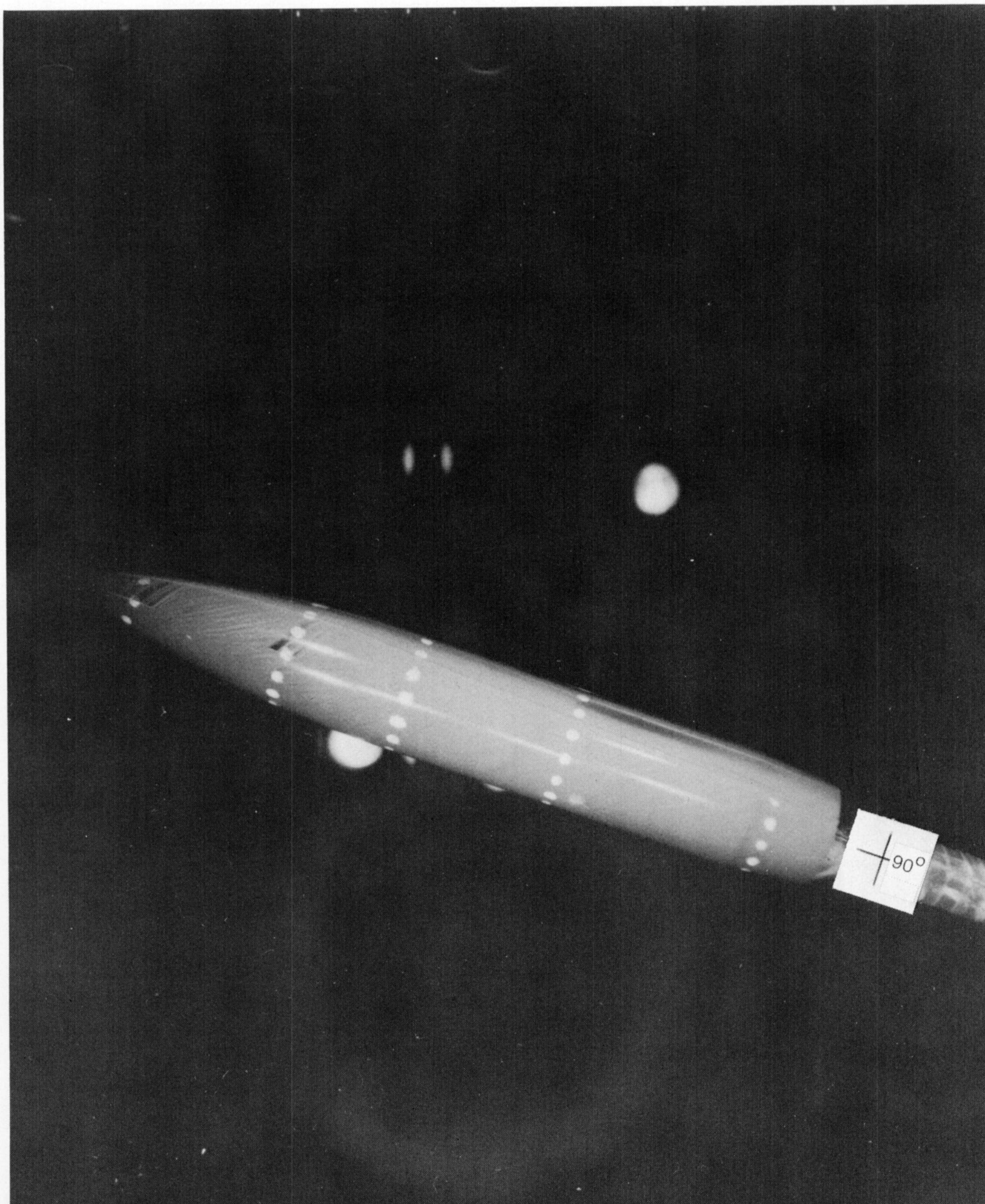
Figure 12.- Continued.



$\alpha = 12^{\circ}$

(d) $M_{\infty} = 4.63$.

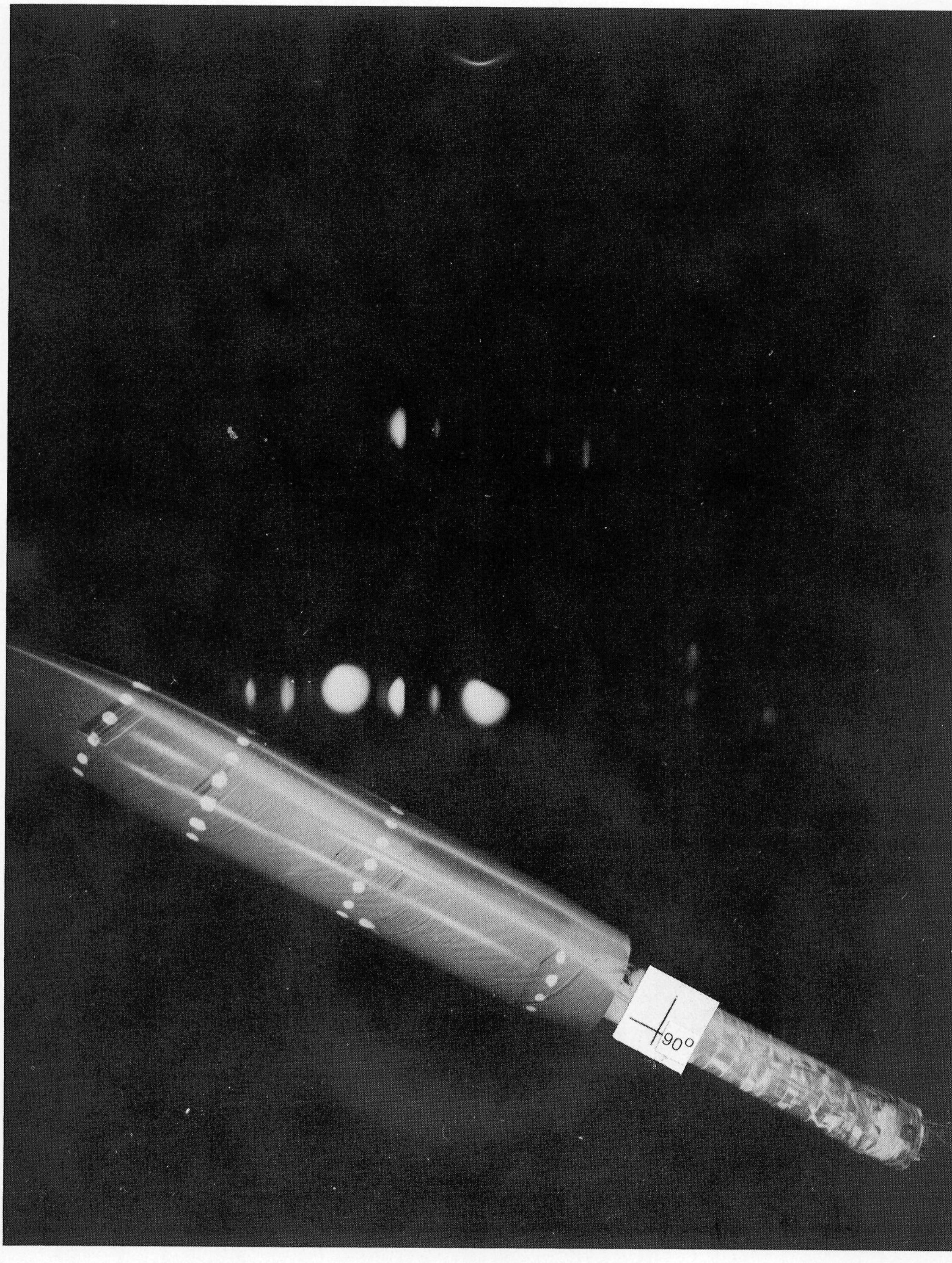
Figure 12.- Continued.



$\alpha = 20^{\circ}$

(d) Continued.

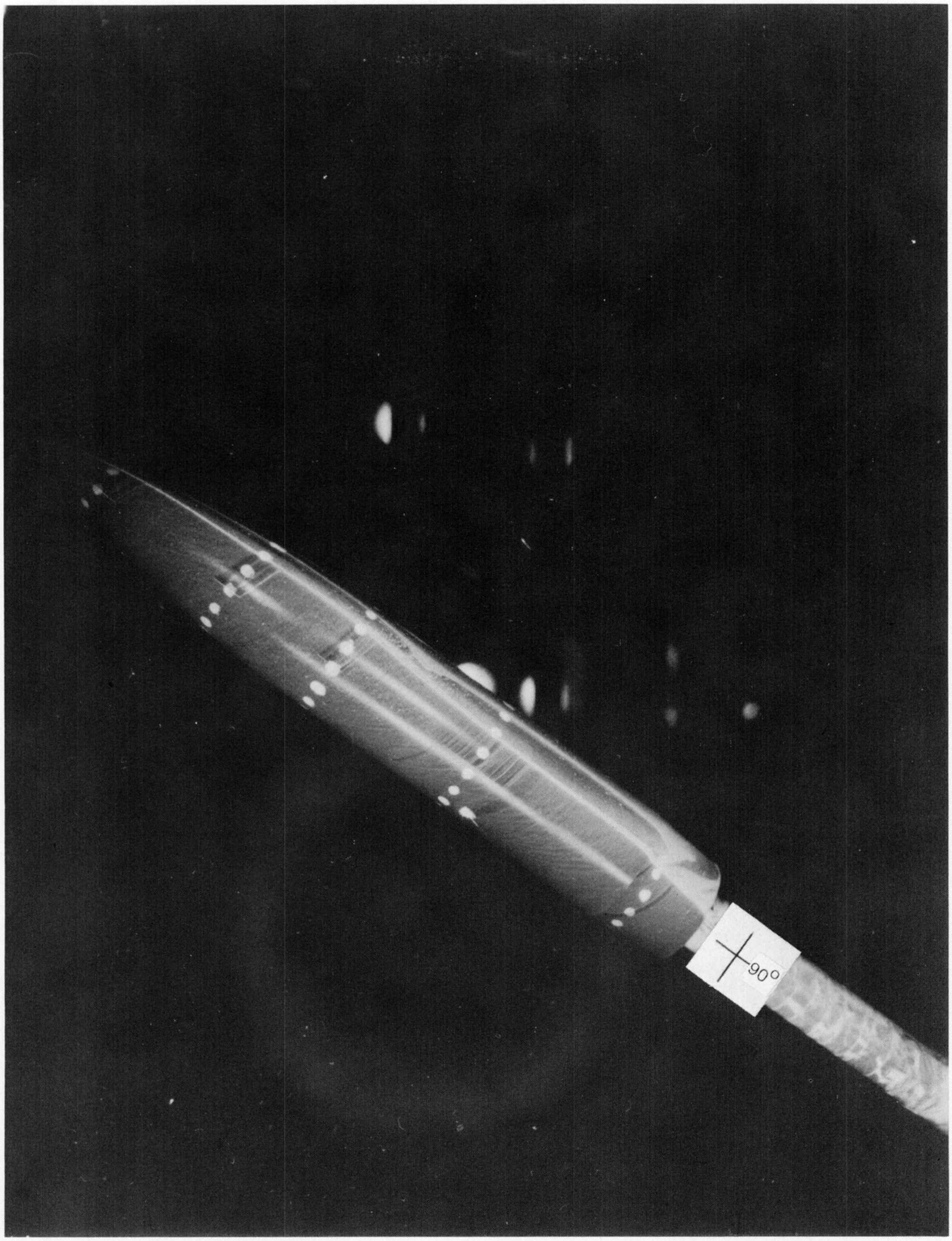
Figure 12.- Continued.



$\alpha = 28^{\circ}$

(d) Continued.

Figure 12.- Continued.



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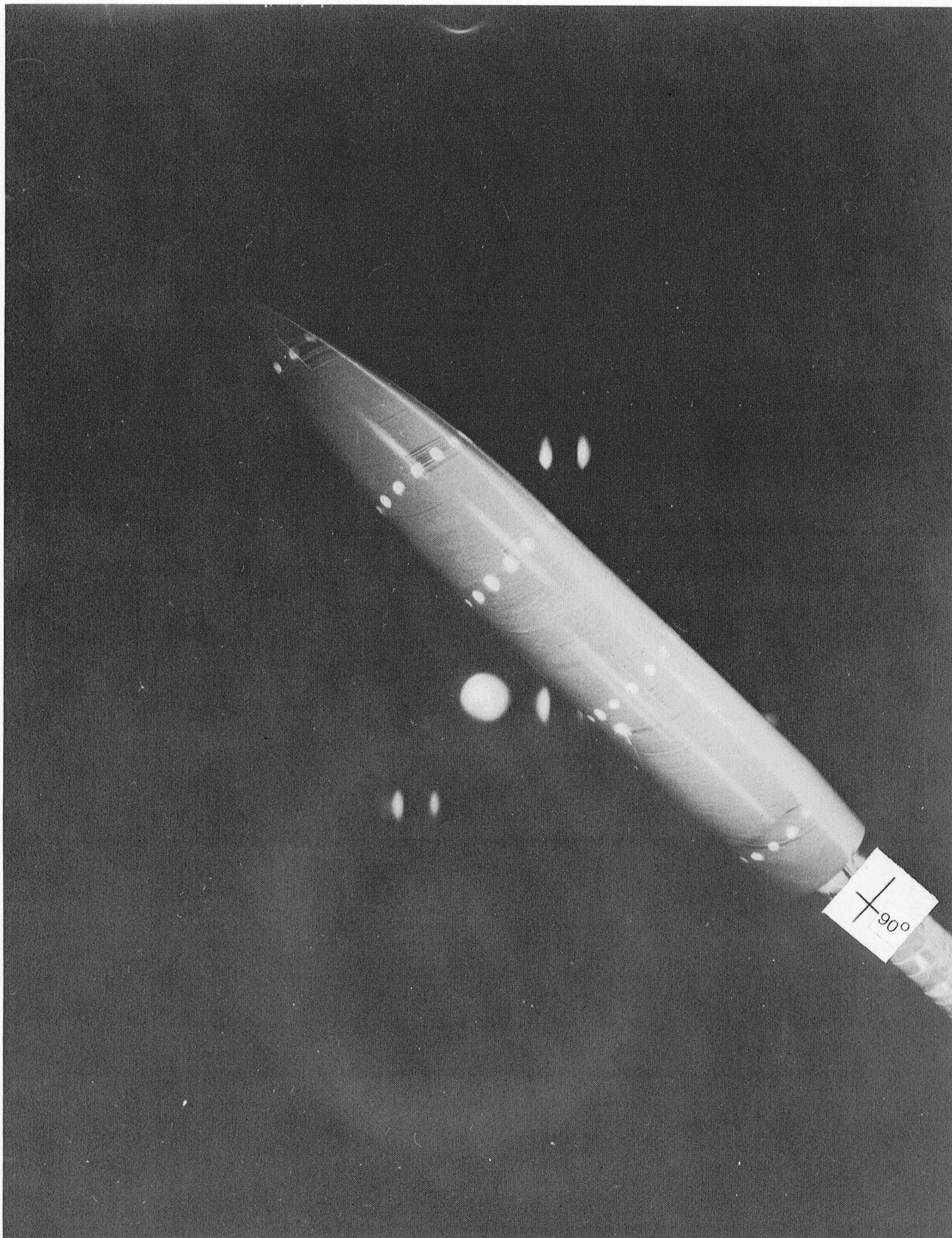
(d) Continued.

Figure 12.- Continued.



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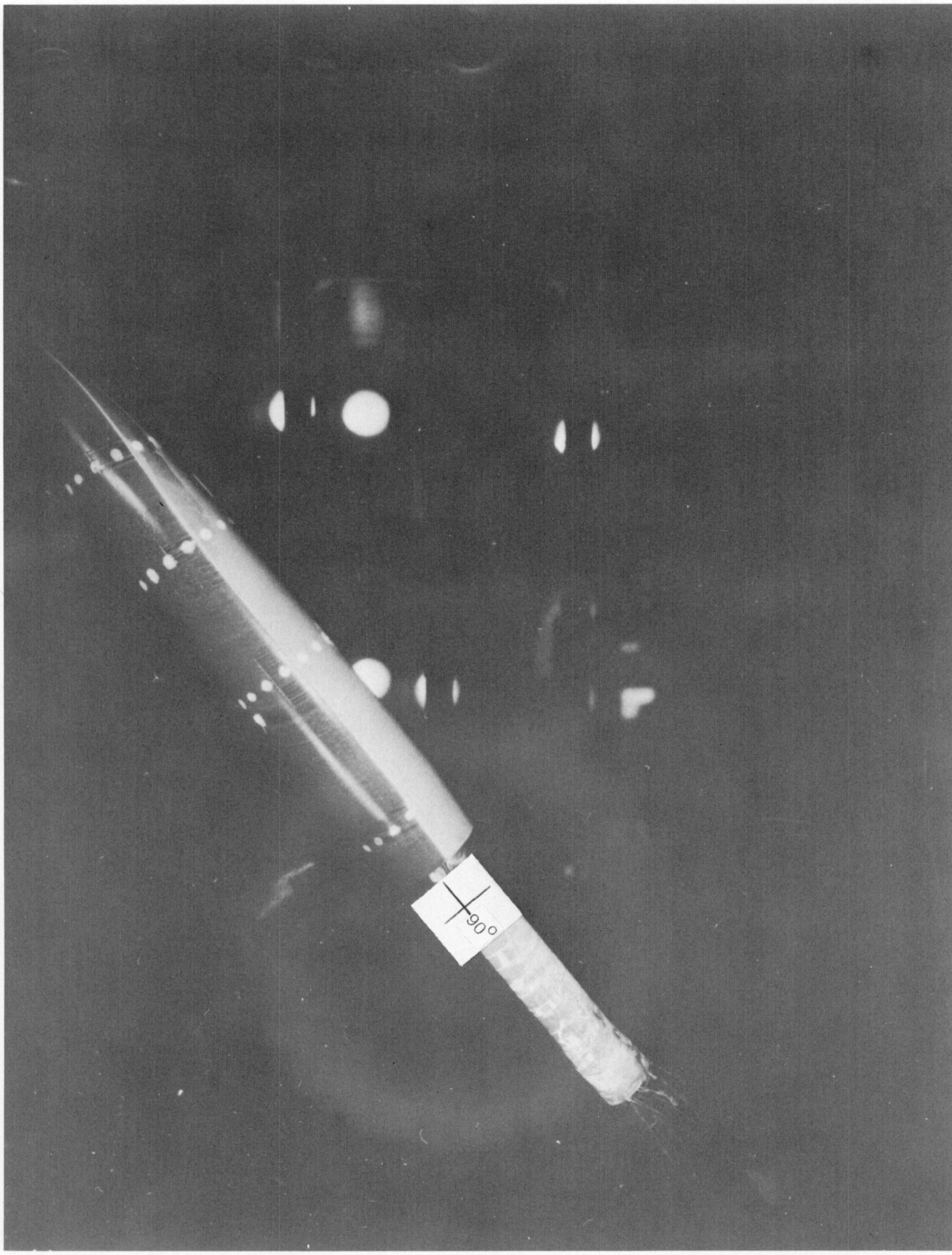
(d) Continued.

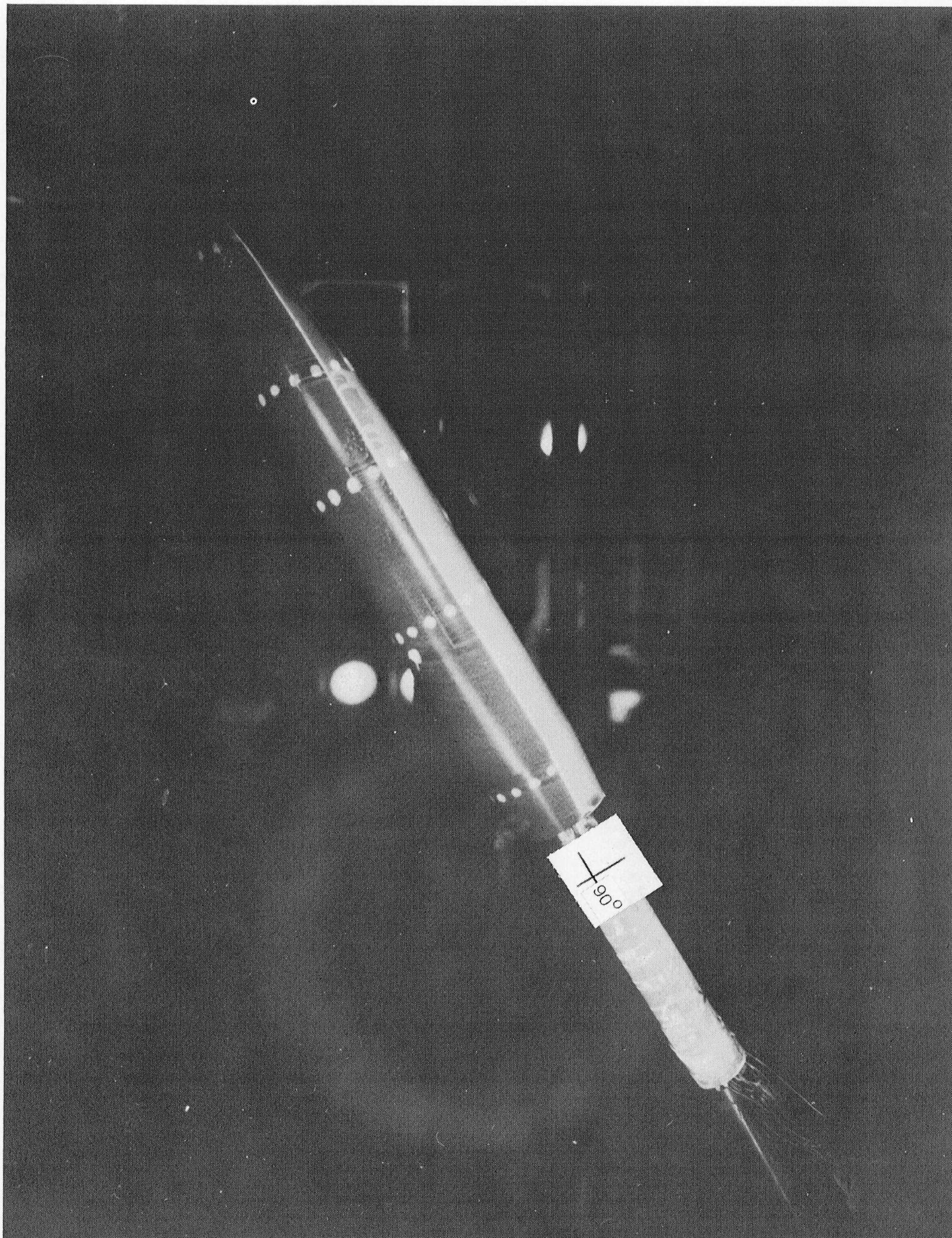
Figure 12.- Continued.



$\alpha = 52^{\circ}$

(d) Continued.

Figure 12.- Continued.



$\alpha = 60^{\circ}$

(d) Concluded.

Figure 12.- Concluded.

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16. Abstract

Flow-visualization and force data for a series of six bodies of revolution are presented without analysis. The data were obtained in the Langley Unitary Plan wind tunnel for angles of attack from -4° to 60°. The Reynolds number used for these tests was 6.6×10^{6} per meter (2.0×10^{6} per foot).

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